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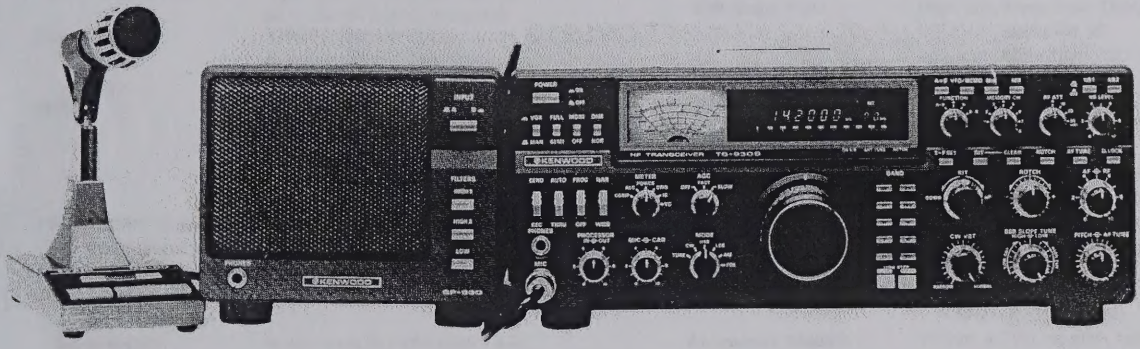
KENWOOD

SERVICE MANUAL

TS-930S SP-930, AT-930, SO-1

HF TRANSCEIVER



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SPECIFICATIONS

[GENERAL]

Transmitter Frequency Range:	160 m Band 1.8 ~ 2.0 MHz
	80 m Band 3.5 ~ 4.0 MHz
	40 m Band 7.0 ~ 7.3 MHz
	*30 m Band 10.1 ~ 10.15 MHz (10.0 MHz WWV)
	20 m Band 14.0 ~ 14.35 MHz
	*17 m Band 18.068 ~ 18.168 MHz
	15 m Band 21.0 ~ 21.45 MHz
	*12 m Band 24.89 ~ 24.99 MHz
	10 m Band 28.0 ~ 29.7 MHz
Receiver Frequency Range:	150 kHz - 30 MHz
Mode:	A3J (USB, LSB), A1 (CW), F1 (FSK), A3 (AM)
Antenna Impedance:	50 ohms
With AT-930 antenna tuner	20 - 150 ohms (80 - 10 meter Amateur bands only)
Power Requirement:	120/220/240 VAC, 50/60 Hz
Power Dissipation:	Max. 510 W during transmission, 80 W during reception
Dimensions:	374(14-3/4″)W × 141 (5-9/16″)H × 350(13-13/16″)D mm (inches)
Weight:	With antenna tuner: Approx. 18.5 kg (40.8 lbs) Without antenna tuner: Approx. 16.8 kg (37.0 lbs)

[TRANSMITTER]

Final Power Input:	SSB/CW/FSK 250 W AM 80 W
Carrier Suppression:	Better than 40 dB
Unwanted Sideband Suppression:	Better than 50 dB (with 1 kHz modulation)
Harmonic Content:	Less than −40 dB
Audio Frequency Response:	400 - 2,600 Hz/−6 dB
Modulation:	SSB: Balanced modulation AM: Low level modulation (IF stage)
FSK Shift:	170 Hz
Modulation Distortion:	Less than −31 dB
Microphone Impedance:	500 ohms or 50 kohms (Connector - switchable)
ALC Input:	−10 V DC MAX
Linear Amplifier Switching:	200 V DC MAX 100 mA

[RECEIVER]

Circuitry:	Quadruple conversion
Intermediate Frequencies:	1st IF: 44.93 MHz 2nd IF: 8.83 MHz 3rd IF: 455 kHz 4th IF: 100 kHz
Sensitivity (at 10 dB S+N/N)	
150 - 500 kHz:	Less than 1 μV for SSB, CW and FSK Less than 10 μV for AM
500 kHz - 1.8 MHz:	Less than 4 μV for SSB, CW and FSK Less than 32 μV for AM
1.8 - 30 MHz:	Less than 0.25 μV for SSB, CW and FSK Less than 2 μV for AM
Image Ratio:	More than 80 dB (1.8 MHz ~ 30 MHz)
IF Rejection:	More than 70 dB (1.8 MHz ~ 30 MHz)
Selectivity (W-wide, N-narrow filter selection)	
SSB, CW(W), FSK(W), AM(N):	2.7 kHz/−6 dB, 4.0 kHz/−60 dB
CW(N), FSK(N):	Without optional filter: same as CW(W), FSK(W) With optional YG-455C-1: 500 Hz/−6 dB, 820 Hz/−60 dB With optional YG-455CN-1: 250 Hz/−6 dB, 480 Hz/−60 dB With optional YK-88C-1: 500 Hz/−6 dB, 1.5 kHz/−60 dB
AM(W):	Without optional filter: 6 kHz/−6 dB, 18 kHz/−60 dB With optional YK-88A-1: 6 kHz/−6 dB, 11 kHz/−60 dB
SSB Slope Tune:	High-cut: More than 1500 Hz shift/−6 dB Low-cut: More than 700 Hz shift/−6 dB
CW VBT	
CW(W), FSK(W) AM(N):	600 Hz ~ 2.7 kHz/−6 dB
CW(N), FSK(N):	Without optional filter: same as CW(W), FSK(W) With optional YK-88C-1 and YG-455C-1 installed: 150 Hz ~ 500 Hz −6 dB
AM(W):	With optional YK-88A-1: 4 kHz ~ 6 kHz/−6 dB
Frequency Stability:	Within ±200 Hz after turn-on Within ±30 Hz any 30 minute period there after at constant temperature
Frequency Accuracy:	$\pm 1 \times 10^{-5}$ or better (at normal temperatures)
RIT Variable Range:	±9.99 kHz
Notch Filter Attenuation:	More than 40 dB
Phone Patch Output Z:	600 Ω
Audio Output Power:	More than 1.5 W across 8 Ω (at 10% distortion)

AT-930 (Automatic Antenna Tuner)

Frequency Range:	Amateur bands from 80 ~ 10 m
Input Impedance:	50 Ω, unbalanced
Output Impedance:	20 ~ 150 Ω unbalanced
Insertion Loss:	Less than 1 dB at 3.5 MHz (at optimum match)
Through Power:	150 W max.
Motor Stop SWR Value:	Less than 1.2

*Will transmit on the new 30, 17, and 12 meter bands. Lock-out circuitry installed to prevent accidental transmission before government amateur authorization.

NOTE: The circuit and ratings may change without notice due to developments in technology.

CIRCUIT DESCRIPTION

GENERAL

The TS-930S receiver is quadraple conversion and the transmitter is double conversion in the TUNE mode and triple conversion in the SSB, AM and FSK modes. Fig. 1 shows the frequency configuration of the receiver and Fig. 2 shows that of the transmitter.

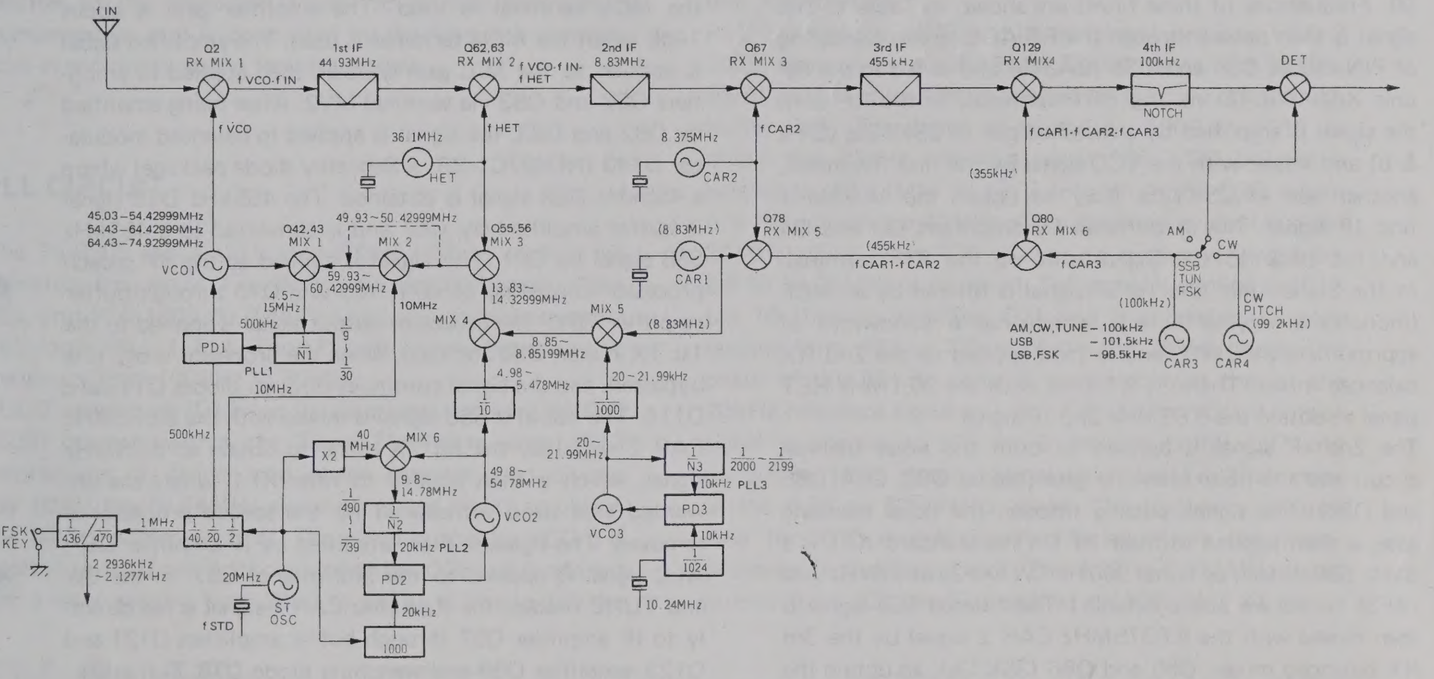

f IN
Q2
RX MIX 1
f VCO-f IN
1st IF
44.93MHz
Q62,63
RX MIX 2
f VCO-f IN-f HET
2nd IF
8.83MHz
Q67
RX MIX 3
3rd IF
455kHz
Q129
RX MIX4
4th IF
100kHz
NOTCH
DET
f VCO
36.1MHz
HET
f HET
8.375MHz
CAR2
f CAR2
f CAR1-f CAR2-f CAR3
(355kHz)
45.03~54.42999MHz
54.43~64.42999MHz
64.43~74.92999MHz
VCO1
Q42,43
MIX 1
49.93~50.42999MHz
MIX 2
Q55,56
MIX 3
59.93~60.42999MHz
(8.83MHz)
CAR1
Q78
RX MIX 5
(455kHz)
f CAR1-f CAR2
Q80
RX MIX 6
f CAR3
AM
CW
SSB
TUN
FSK
4.5~15MHz
500kHz
PD1
1/N1
PLL1
1/9 ~ 1/30
10MHz
MIX 4
13.83~14.32999MHz
MIX 5
(8.83MHz)
8.85~8.85199MHz
(100kHz)
AM,CW,TUNE – 100kHz
USB – 101.5kHz
LSB,FSK – 98.5kHz
CAR3
CW PITCH (99.2kHz)
CAR4
10MHz
4.98~5.478MHz
1/10
20~21.99kHz
1/1000
500kHz
X2
40MHz
MIX 6
20~21.99MHz
1/N3
1/2000 ~ 1/2199
10kHz
PLL3
9.8~14.78MHz
49.8~54.78MHz
VCO3
PD3
10kHz
FSK KEY
1/436 / 1/470
1MHz
1/40, 1/20, 1/2
1/490 ~ 1/739
1/N2
VCO2
1/1024
2.2936kHz ~2.1277kHz
20MHz
ST OSC
f STD
20kHz PLL2
PD2
20kHz
1/1000
10.24MHz

Fig. 1 RX Frequency configuration

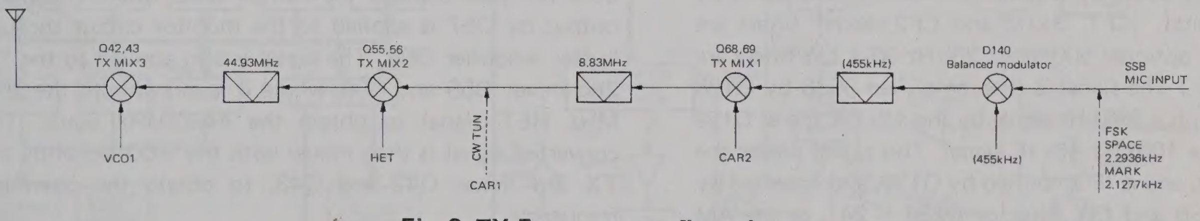

Q42,43
TX MIX3
44.93MHz
Q55,56
TX MIX2
8.83MHz
Q68,69
TX MIX1
(455kHz)
D140
Balanced modulator
SSB
MIC INPUT
VCO1
HET
CW TUNE
CAR1
CAR2
(455kHz)
FSK
SPACE 2.2936kHz
MARK 2.1277kHz

Fig. 2 TX Frequency configuration

● VCOs (voltage controlled oscillators) in the Signal unit

There are three VCOs in the Signal unit X57-1000-11. Q16 operates at 45.03 to 54.42999MHz, Q15 at 54.43 to 64.42999MHz and Q14 at 64.43 to 74.9299MHz, the first VCO is used for operation from 100kHz to 9.49999MHz, the second from 9.5 to 19.49999MHz and the last from 19.5 to 29.99999MHz.

● HET (heterodyne) generation in the Signal unit

Oscillator Q25 uses a 3rd overtone crystal to generate a 36.1MHz heterodyne signal.

● CAR 1 in the Signal unit

Q119 operates at 8.83MHz with crystal X5 for the CW, TUNE and AM modes ; at 8.8315MHz with X3 for the USB mode ; and at 8.8285MHz with X4 for the LSB and FSK modes. (CAR 1 frequency shifts to 8.82779MHz in the FSK mode.) The CAR 1 oscillator is a VXO (variable crystal oscillator) which, together with the CAR 2 oscillator, forms the SSB-slope-tune and CW-VBT circuits.

● CAR 2 in the Signal unit

Q75 is a VXO, operating at 8.375MHz.

● CAR 3 in the Signal unit

Q140 operates at 100kHz for the CW, TUNE and AM modes ; at 101.5kHz for the USB mode ; and at 98.5kHz for the LSB mode. This output is fed to the 2nd CAR mixer Q80 and to Q152 as signal CAR in the SSB, TUNE and FSK modes and as the carrier in the CW mode.

● CAR 4 in the Signal unit

Q158 operates at 99.2kHz and is used for both demodulating CW signals and generating the CW side tone.

CIRCUIT DESCRIPTION

RX SECTION

The signal from the antenna is applied to the Signal unit X57-1000-11 RAT terminal, then applied to a low pass filter or one of 8 band pass filters through a 10dB or 20dB RF attenuator. The filters are selected according to BAND data (RB0 – RB3) output from the Digital unit X54-1670-00. Frequencies of these filters are shown in Table 1. The signal is then passed through the RF AGC circuit consisting of PIN diodes D34 and D35 (BA379) and is fed to the RF unit X44-1490-00 via the RRF terminal. In the RF unit, the signal is amplified by a matched pair of 2SK125s (Q1 a & b) and mixed with the VCO signal by the first RX mixer, another pair of 2SK125s (Q2), to obtain the 44.93MHz first IF signal. This is buffered by amplifiers Q3 and Q4 and fed back to the Signal unit via the RIF terminal. In the Signal unit, the 1st IF signal is filtered by an MCF (monolythic crystal filter), which has a bandwidth of approximately 10kHz, and is then applied to the 2nd RX balanced mixer. There, it is mixed with the 36.1MHz HET signal to obtain the 8.83MHz 2nd IF signal.

The 2nd IF signal is applied to both the noise blanker circuit and the noise blanking gate (diodes D82, D84, D85 and D86). The signal, passing through the noise blanking gate, is then applied to filter XF1. (The standard XF1 is a 3kHz SSB filter ; optional 500Hz CW (XF2) and 6kHz AM (XF3) filters are also available.) The filtered SSB signal is then mixed with the 8.8375MHz CAR 2 signal by the 3rd RX balanced mixer, Q65 and Q66 (3SK73s), to obtain the 455kHz 3rd IF signal. The 3rd IF signal is amplified approximately 30dB by IF amplifier Q67, then filtered by a ceramic filter. (CF1, 3kHz and CF2, 6kHz filters are built in, and optional 500Hz or 250Hz XF4 CW filters are also available.) The signal is then amplified 30dB by Q128 and mixed with a 355kHz signal by the 4th RX mixer Q129 to obtain the 100kHz 4th IF signal. This signal passes the notch circuit, and is IF amplified by Q130, and detected by either the SSB and CW detector D238 – 241, or the AM detector, depending on the mode. The detected audio signal is amplified by the 2-stage AF amplifier Q159, 160, then power amplified by IC3 to drive the speaker.

BAND	Frequency (MHz)
A	~ 0.5
B	0.5 ~ 1.5
C	1.5 ~ 3
D	3 ~ 4
E	4 ~ 7
F	7 ~ 8.5
G	8.5 ~ 14
H	14 ~ 20
I	20 ~ 30

Table 1 RX BPF frequency

TX SECTION

The microphone signal is applied to the microphone input terminal MCL (for 500Ω microphones). Terminal MCH is provided for 50kΩ microphone and is selected by moving the connector. The MIC amplifier, consisting of Q146 and Q147, amplifies the signal by approximately 34dB when the MCL terminal is used. The amplifier gain is about 14dB when the MCH terminal is used. The amplified signal is applied to the MIC gain control, then applied to amplifiers Q82 and Q83 via terminal MV2. After being amplified by Q82 and Q83, the signal is applied to balanced modulator D140 (ND487C1-3R, a Schottky diode package) where a 455kHz DSB signal is obtained. The 455kHz DSB signal is buffer amplified by Q87 and is converted to a 455kHz SSB signal by CF1. This signal is applied to the RF speech processor consisting of Q71, IC6 and Q70 through buffer amplifier Q72. The processor output signal is applied to the 1st TX mixer, Q68 and Q69. When the processor is off, it is bypassed, and the signal continues through diodes D118 and D114. The 455kHz SSB signal is mixed with the 8.375MHz CAR 2 signal by the 1st TX mixer to obtain an 8.83MHz signal, which is then applied to filter XF1, where the unwanted side band introduced by the speech processor is removed. The signal is then amplified by IF amplifier Q57. ALC signal is applied to the 2nd gate of Q57. In the CW and TUNE modes, the 8.83MHz CAR 1 signal is fed directly to IF amplifier Q57 through buffer amplifiers Q121 and Q123, amplifier Q59 and switching diode D78. Full break-in is possible in these modes because the transmission signal does not pass through the narrow band filter. The signal output by Q57 is applied to the monitor circuit through buffer amplifier Q58. The signal is also applied to the TX 2nd mixer Q55 and Q56, where it is mixed with the 36.1 MHz HET signal to obtain the 44.93MHz signal. The converted signal is then mixed with the VCO signal by the TX 3rd mixer Q42 and Q43, to obtain the operating frequency.

It is then amplified approximately 22dB by wide band amplifiers Q41, Q40 and Q43, after unwanted signal components are removed by one of the TX band pass filters. The amplified signal is output from the DRV terminal and fed to the Final unit X56-1430-00. The drive signal line to the Final unit is automatically disconnected when a cable is connected to the transverter connector on the rear panel.

In the Final unit, the signal is amplified approximately 40dB by a three-stage wide band amplifier consisting of pre-driver Q1 (2SC2075), a push-pull driver (Q2 and Q3 ; MRF485s) and a push-pull final amplifier (Q4 and Q5 ; MRF422s). The amplified signal is then applied to the antenna through the Filter unit X51-1280-00, (optional) AT (antenna tuner) unit X57-1010-00 and Switch unit X41-1410-00. There are two models of the TS-930S : one with and one without the AT unit. The final amplifier uses

CIRCUIT DESCRIPTION

Motorola transistors, having an excellent IMD (intermodulation distortion) characteristic, a maximum collector dissapation (PC) of 290W and high reliability. 28V DC is applied to each transistor. The bias circuits for the predriver and driver are regulated by varistors and a transistor. The bias circuit for the final transistors is regulated by IC1 and Q7, and the diode characteristic between the base and emitter of the transistor is used to provide temperature compensation and is controlled by the heat sink temperature in proximity to the final transistors.

PLL CIRCUIT

The TS-930S uses a 10Hz step digital VFO to control the operating frequency. Fig. 3 shows a block diagram of the PLL unit X50-1880-00. The PLL circuit uses three separate PLL loops (PLL-1, PLL-2 and PLL-3) to vary the operating frequency from 100kHz to 30MHz.

PLL-3 consists of IC13 and its peripheral circuitry. VCO-3 (Q29) operates within the 20 to 21.99MHz range. IC13 incorporates a divider and phase detector, and divides (by 1024) the 10.24MHz signal generated by X2 to obtain the 10kHz reference signal. The signal output by VCO-3 is applied to IC13 pin 9 through amplifier Q28 and is divided (by a value ranging from 2000 to 2199) to obtain 10kHz. The phase of this 10kHz signal is compared with that of the 10kHz reference signal to lock VCO-3. The locked VCO-3 signal is applied to IC9 pin 14 through buffer Q33. The signal is divided by 1000 in IC9, IC10 and IC11 to obtain a signal which varies in 10Hz steps in the 20 to 21.99kHz range. The frequency division data for IC13 is delivered serially from the microprocessor in the Digital unit X54-1670-00.

PLL-2 consists of IC15 and its peripheral circuitry. VCO-2 (Q25) operates in the 49.8 to 54.78MHz range. The 20MHz signal generated by Q36 is applied to IC15 pin 19 through buffer Q34. This signal is divided by 1000 by IC15 to obtain the 20kHz reference signal. The VCO-2 signal is applied to IC14 (MIX 6) pin 2 through buffer Q26, where it is mixed with the 40MHz signal obtained by doubling the 20MHz signal from Q34 so that an output varying from 9.8 to 14.78MHz is obtained. This signal is applied to IC15 pin 10 through amplifier Q21 and is divided by a value ranging form 490 to 739 to obtain the 20kHz signal. The phase of this 20kHz signal is compared with that of the 20kHz reference signal to lock VCO-2. The VCO-2 output signal is applied to IC8 pin 2 through buffer Q27 and divided by 10 to obtain a signal which varies in 2kHz steps in the 4.98 to 5.478MHz range. The frequency division data for IC15 is also delivered serially from the microprocessor in the Digital unit. The 4.98 to 5.478MHz signal output from IC8 pin 5 is applied to IC6 (MIX 4) pin 2.

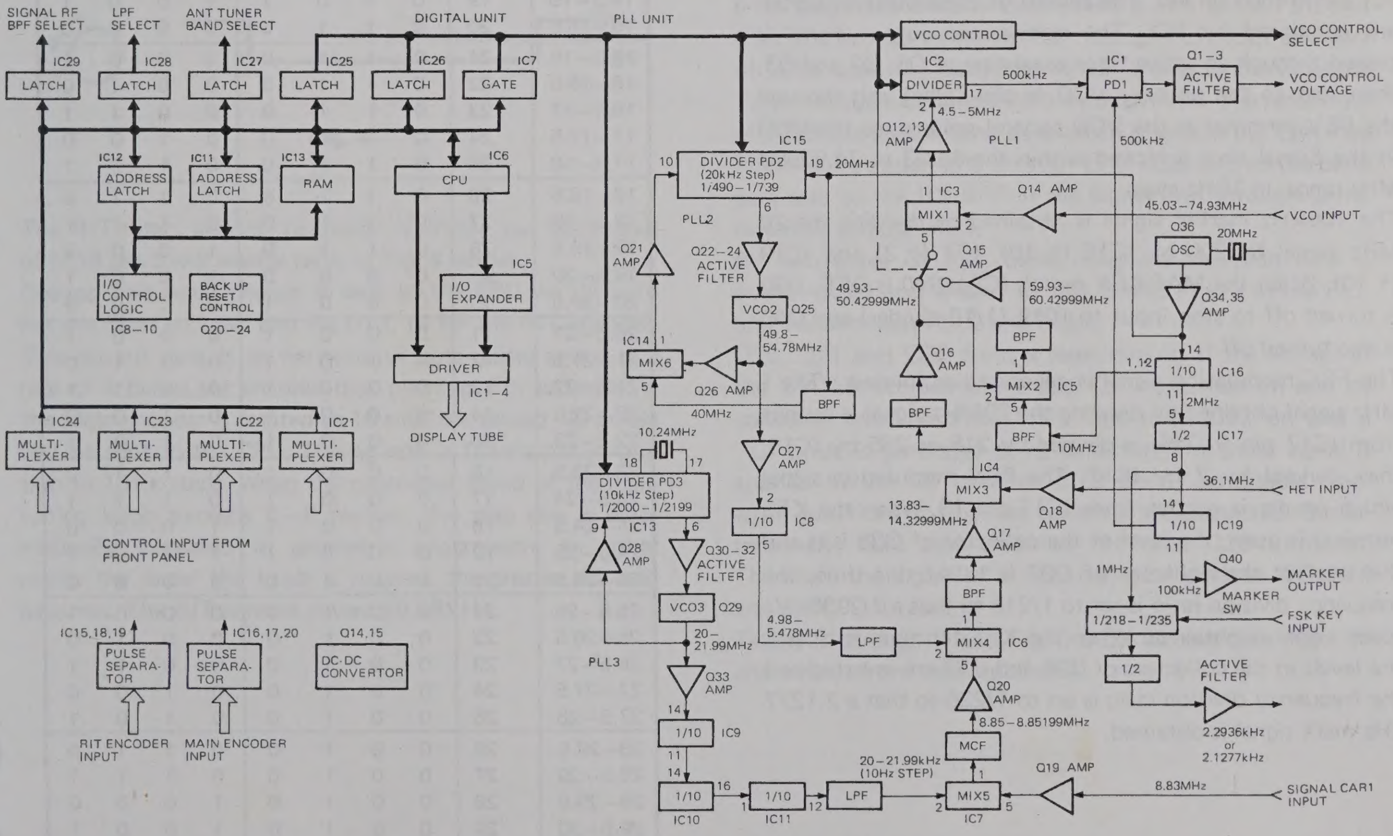

SIGNAL RF BPF SELECT
LPF SELECT
ANT TUNER BAND SELECT
DIGITAL UNIT
PLL UNIT
IC29 LATCH
IC28 LATCH
IC27 LATCH
IC25 LATCH
IC26 LATCH
IC7 GATE
IC12 ADDRESS LATCH
IC11 ADDRESS LATCH
IC13 RAM
IC6 CPU
IC5 I/O EXPANDER
I/O CONTROL LOGIC IC8–10
BACK UP RESET CONTROL Q20–24
DRIVER IC1–4
DISPLAY TUBE
IC24 MULTI-PLEXER
IC23 MULTI-PLEXER
IC22 MULTI-PLEXER
IC21 MULTI-PLEXER
CONTROL INPUT FROM FRONT PANEL
IC15,18,19 PULSE SEPARA-TOR
IC16,17,20 PULSE SEPARA-TOR
Q14,15 DC-DC CONVERTOR
RIT ENCODER INPUT
MAIN ENCODER INPUT
VCO CONTROL
VCO CONTROL SELECT
IC2 DIVIDER
500kHz
IC1 PD1
Q1–3 ACTIVE FILTER
VCO CONTROL VOLTAGE
4.5–5MHz
Q12,13 AMP
PLL1
500kHz
IC15 DIVIDER PD2 (20kHz Step) 1/490–1/739
20MHz
IC3 MIX1
Q14 AMP
45.03–74.93MHz
VCO INPUT
Q36 OSC
20MHz
PLL2
Q21 AMP
Q22–24 ACTIVE FILTER
Q15 AMP
VCO2 Q25
49.93–50.42999MHz
59.93–60.42999MHz
Q34,35 AMP
49.8–54.78MHz
IC14 MIX6
Q26 AMP
40MHz
BPF
Q16 AMP
BPF
IC5 MIX2
BPF
BPF
10MHz
1/10 IC16
2MHz
1/2 IC17
10.24MHz
DIVIDER PD3 (10kHz Step) 1/2000–1/2199
IC13
Q27 AMP
IC4 MIX3
36.1MHz
HET INPUT
Q18 AMP
13.83–14.32999MHz
1/10 IC8
Q17 AMP
1/10 IC19
Q28 AMP
Q30–32 ACTIVE FILTER
1MHz
Q40
100kHz
MARKER SW
MARKER OUTPUT
VCO3 Q29
BPF
20–21.99MHz
4.98–5.478MHz
LPF
IC6 MIX4
1/218–1/235
FSK KEY INPUT
PLL3
1/2
ACTIVE FILTER
Q33 AMP
Q20 AMP
8.85–8.85199MHz
2.2936kHz or 2.1277kHz
1/10 IC9
MCF
20–21.99kHz (10Hz STEP)
Q19 AMP
8.83MHz
SIGNAL CAR1 INPUT
1/10 IC10
1/10 IC11
LPF
IC7 MIX5

Fig. 3 PLL Block diagram and Digital control system

CIRCUIT DESCRIPTION

The 20 to 21.99kHz signal from IC11 pin 12 is mixed with the 8.83MHz CAR 1 signal to obtain the 8.85 to 8.85199 MHz signal. This signal is applied to IC5 pin 5 through MCF1, MCF2 and buffer Q20, where it is mixed with the 4.98–5.478MHz signal from PLL-2, the resultant signal varies from 13.83 to 14.32999MHz in 10Hz steps. This is applied to IC4 (MIX 3) through buffer Q17 and is mixed with the 36.1MHz HET signal to obtain a signal which varies from 49.93 to 50.42999MHz in 10Hz steps. After being buffered by Q16, the signal is applied directly to IC3 (MIX 1) pin 5 when the operating frequency is between 9.5 and 19.49999MHz. When the operating frequency is between 100kHz and 9.49999MHz, or between 19.5 and 29.99999MHz, the output signal from Q16 is applied to IC5 (MIX 2) pin 2 through switching diode D15 and is mixed with a 10MHz signal, obtained by dividing the 20MHz signal by 2. The resulting 59.93 to 60.42999MHz signal is applied to IC3 through buffer Q15. Diode switching control, is applied according to the operating frequency by the Digital unit microprocessor.

In IC3, the above signal is mixed with the VCO signal, which varies from 45.03 to 74.92999MHz, so that an output varying from 4.5MHz to 15MHz is obtained. This is applied to IC2 (divider) pin 2 through Q13 and Q12, and is divided by a value ranging from 9 to 30 to obtain a 500 kHz signal. This 500kHz signal is applied to IC1 (phase detector) pin 7. The 500kHz from IC19 pin12 is applied to IC1 pin 8 through Q4. The phases of these 500kHz signals are compared by IC1. The comparator output signal is passed through an active filter consisting of Q1, Q2 and Q3, then sent to the primary VCO in the Signal unit through the FCV terminal as the VCO control voltage, so the VCO in the Signal unit is locked within the 45.03 to 74.92999 MHz range, in 10Hz steps.

The 100kHz marker signal is obtained by dividing the 20 MHz signal by 200 by IC16 (÷ 10), IC7 (÷ 2) and IC19 (÷ 10). When the MARKER switch (CAL SW) is OFF, D20 is turned off to stop input to IC19 (1/10 divider) and Q40 is also turned off.

The FSK modulation signal is generated as follows : The 1 MHz signal obtained by dividing the 20MHz signal is output from IC17 pin 9. This is divided by 218 or 235 by IC18, then divided by 2 by IC17. The FSK modulation signal which results is output from IC17 pin 13. When the KFS terminal is open, the level at the collector of Q38 is H and the level at the collector of Q37 is L. At this time, the frequency division ratio is set to 1/218 so that a 2.2936kHz space signal is obtained. When the KFS terminal is closed, the levels at the collectors of Q38 and Q37 are reversed and the frequency division ratio is set to 1/235 so that a 2.1277 kHz mark signal is obtained.

BAND f (MHz)	1/N	PL7	PL6	PL5	PL4	PL3	PL2	PL1	PL0
0.1–0.5	N=30	1	0	1	1	0	0	0	0
0.5–1	29	1	0	1	0	1	0	0	1
1–1.5	28	1	0	1	0	1	0	0	0
1.5–2	27	1	0	1	0	0	1	1	1
2–2.5	26	1	0	1	0	0	1	1	0
2.5–3	25	1	0	1	0	0	1	0	1
3–3.5	24	1	0	1	0	0	1	0	0
3.5–4	23	1	0	1	0	0	0	1	1
4–4.5	22	1	0	1	0	0	0	1	0
4.5–5	21	1	0	1	0	0	0	0	1
5–5.5	20	1	0	1	0	0	0	0	0
5.5–6	19	1	0	0	1	1	0	0	1
6–6.5	18	1	0	0	1	1	0	0	0
6.5–7	17	1	0	0	1	0	1	1	1
7–7.5	16	1	0	0	1	0	1	1	0
7.5–8	15	1	0	0	1	0	1	0	1
8–8.5	14	1	0	0	1	0	1	0	0
8.5–9	13	1	0	0	1	0	0	1	1
9–9.5	12	1	0	0	1	0	0	1	0
9.5–10	9	0	1	0	0	1	0	0	1
10–10.5	10	0	1	0	1	0	0	0	0
10.5–11	11	0	1	0	1	0	0	0	1
11–11.5	12	0	1	0	1	0	0	1	0
11.5–12	13	0	1	0	1	0	0	1	1
12–12.5	14	0	1	0	1	0	1	0	0
12.5–13	15	0	1	0	1	0	1	0	1
13–13.5	16	0	1	0	1	0	1	1	0
13.5–14	17	0	1	0	1	0	1	1	1
14–14.5	18	0	1	0	1	1	0	0	0
14.5–15	19	0	1	0	1	1	0	0	1
15–15.5	20	0	1	1	0	0	0	0	0
15.5–16	21	0	1	1	0	0	0	0	1
16–16.5	22	0	1	1	0	0	0	1	0
16.5–17	23	0	1	1	0	0	0	1	1
17–17.5	24	0	1	1	0	0	1	0	0
17.5–18	25	0	1	1	0	0	1	0	1
18–18.5	26	0	1	1	0	0	1	1	0
18.5–19	27	0	1	1	0	0	1	1	1
19–19.5	28	0	1	1	0	1	0	0	0
19.5–20	9	0	0	0	0	1	0	0	1
20–20.5	10	0	0	0	1	0	0	0	0
20.5–21	11	0	0	0	1	0	0	0	1
21–21.5	12	0	0	0	1	0	0	1	0
21.5–22	13	0	0	0	1	0	0	1	1
22–22.5	14	0	0	0	1	0	1	0	0
22,5–23	15	0	0	0	1	0	1	0	1
23–23.5	16	0	0	0	1	0	1	1	0
23.5–24	17	0	0	0	1	0	1	1	1
24–24.5	18	0	0	0	1	1	0	0	0
24.5–25	19	0	0	0	1	1	0	0	1
25–25.5	20	0	0	1	0	0	0	0	0
25.5–26	21	0	0	1	0	0	0	0	1
26–26.5	22	0	0	1	0	0	0	1	0
26.5–27	23	0	0	1	0	0	0	1	1
27–27.5	24	0	0	1	0	0	1	0	0
27.5–28	25	0	0	1	0	0	1	0	1
28–28.5	26	0	0	1	0	0	1	1	0
28.5–29	27	0	0	1	0	0	1	1	1
29–29.5	28	0	0	1	0	1	0	0	0
29.5–30	29	0	0	1	0	1	0	0	1

Table 2 PLL data

CIRCUIT DESCRIPTION

DIGITAL CIRCUIT

Fig. 3 shows a block diagram of the Digital unit, which consists of 31 ICs including a custom CPU, μPD8049C-211 (IC6). The CPU uses a mapped I/O system on a common bus to control many signals. I/O signals are latched by IC25–29 to prevent noise from affecting other circuits. There are two encoder input ports ; one for the main tuning control signal and the other for the RIT control signal. Each encoded input is applied to a logic circuit that determines both direction of rotation also sends information to the CPU to indicate the desired frequency change. The output of IC16 pin 3 or 4 determines the direction of rotation of the Main encoder. For example, when the encoder is rotated, the output at pin 4 goes to +5V. This output level is maintained until rotation is stopped. The output then returns to 0V. If the dial is turned in the opposite direction, the output drops to −5V and is maintained until rotation is again stopped. Internal variations in IC16 itself determine which pin (3 or 4) must be connected for proper action of the main tuning dial.

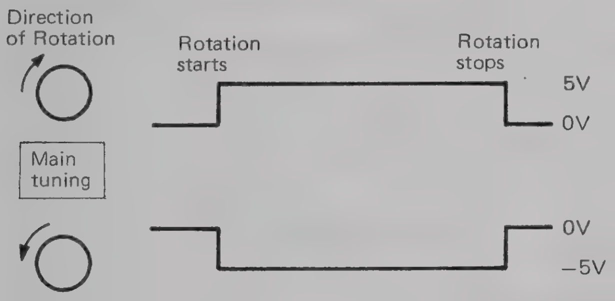


Fig. 4

The RIT rotary encoder operation is similar, but the output of IC19 pin 3 will always be as in Fig. 4, above.

Desired frequency change is sent to the CPU via D13, 14 for the Main encoder and via D18, 19 for the RIT encoder. This output data is in the form of data pulses and is at a rate of 4 pulses per encoder disk opening. For example, If the Main encoder is rotated so 10 slots are sensed, 40 pulses will be sent to the CPU. Tuning rate is 10 kHz per revolution in 10 Hz steps. When the rotational speed of the main tuning knob exceeds 5–6 rev/sec, the step size is automatically increased in geometric progression. In other words the faster the knob is rotated, the greater the step becomes. The RIT control covers ±9.99 kHz.

IC13 (μPD5101LC) is a C-MOS RAM which stores frequency data for the 8 memory channels, and VFOs A and B. IC13 back-up power is supplied by three 1.5V AA batteries, through diode D10, when the power switch is OFF. Since the required back-up current is only 10μA, memories will be maintained for approximately 24hr, even if no batteries are installed, by the discharge current of C21. Power is supplied to IC13 through Q23 and Q24 when the power switch is ON.

IC1 through IC4 are display drivers. Display date is multiplexed from the microprocessor. Connectors 13 through 16 output to the display tube. Terminals a through g and DP are 7 segment and decimal point data ,for the display. Terminals P1 through P10 are signals for the analog-type display, which approximates a conventional dial pointer. Terminals G1 through G10 are display tube grid signals. Heater voltage at approximately 7 Vpp is generated by DC-DC converter Q14 and Q15 and is supplied to the display tube terminals FH and FG. Q16 is a switching transistor used to blank the display tube if the PLL unlocks. IC21 through IC24 are multiplexers. Whenever the collector of Q25 is "L" low, data from the inputs of IC21–24 (pins D0–D6) is distributed to the appropriate IC. Input data selection is by means of control signal from IC12 the address latch (pins Q1, Q2 and Q3). If the collector of Q25 is held "H" no data transfer can occur.

IC11 and IC12 form an 8-bit address latch and IC25 through IC29 are output data latches : IC25 and IC26 latch 8-bit frequency division data which is sent to the PLL unit (PLL-1) through terminals PL0 through PL7. IC27 and part of IC28 latch the band data which is sent to the Antenna Tuner through terminals AT0 through AT4. The remainder of IC28 latches the band data which is sent to the Low Pass Filter unit through LP0 through LP2. IC29 latches the band data sent to the RX BPF in the Signal unit through terminals RB0 through RB3.

By two gates of IC7, Serial frequency division data is output-gated and is sent to PLL-2 and PLL-3 in the PLL unit via terminals PLL2 and PLL1.

Q20, Q21 and Q22 form a reset circuit. If the voltage at the 5V line accidentally drops, Q21 is turned on and its collector level becomes "H". This turns Q22 on and a "L" pulse is generated at its collector. This pulse signal is applied to the CE terminal IC13 pin 17 to disable read-write functions so that its contents are protected. Simultaneously, Q20 base becomes "H" and Q20 turns on. Therefore the logic "L" at Q20 collector is felt at IC6 pin 4 and the CPU is reset.

Tables 3 through 5 and Fig. 5 show various data input to and output from the Digital unit.

CIRCUIT DESCRIPTION

Terminals			Functions
No.		Name	
①	1	24I	DC-DC converter input approx. 24V.
	2	12I	AVR input.
	3	5I	AVR input.
②	1	BZ	Signal unit tone oscillator on when "L".
	2	BRK	When the Main knob is turned, a L pulse is output for the NB gate at every 2kHz step.
	3	UL	PLL unlock input, L : unlock, display blanks.
	4	TS	"L" plus is output when changing BAND, TX stops when "L".
	5	−C	Approx. −43V.
	6	TR	TX and RX switching signal input, "L" in RX, "H" in TX.
③	1	G	GND
	2	BAT	Back up DC input 1.5V x 3.
④	1	5V	5V DC.
	2	ME2	Main encoder input, 90° phase difference, 50% duty cycle.
	3	ME1	
	4	G	GND
⑤	1	5V	5V DC.
	2	RE2	RIT encoder input, 90° phase difference, 50% duty cycle.
	3	RE1	
	4	G	GND
⑥	1	DM	Dimmer at open, normally GND.
	2	—	Not used.
	3	M0	Memory channel M0.
	4	CLR	Normally "H", RIT f is cleared when "L".
	5	B0	BAND DATA input B0.
	6	FR	VFO select on RX, VFO B at "H", VFO A at "L".
	7	RIT	Normally "H", RIT-ON, OFF state changes at "L".
	8	BD	1MHz step BAND DATA, f descends 1MHz steps in at "L".
	9	—	Not used.
	10	B1	BAND DATA input B1.
	11	AB	VFO A=B switch, VFO A=B when "L".
	12	M1	Memory CH M1.
⑦	1	LOCK	Main dial f is locked when "L".
	2	MV	Memory and VFO select, VFO at "H", Memory at "L".
	3	BU	1MHz step BAND UP DATA input, frequency ascends in 1MHz steps when "L" is input.
	4	MD	MIC DOWN input, "L" : DOWN.
	5	—	Not used.
	6	B3	BAND DATA B3.
	7	MR	Memory recall at "L".
⑧	1	—	Not used.
	2	MU	MIC UP input, "L" : UP.
	3	—	Not used.
	4	M2	Memory CH M2.
	5	MIN	Memory in at "L".
	6	FSK	"H" at FSK mode, increases ref. f 2.29kHz.
	7	B2	BAND DATA B2.
	8	FT	VFO select in transmit, VFO B at "H", VFO A at "L".
⑨	1	12V	12V DC to PLL unit.
	2	UL	Unlock signal at "L" from PLL unit.
	3	PL3	PLL DATA for 500kHz comparison.
	4	PL2	
	5	PL4	
	6	PL1	
	7	PL0	

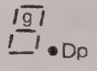
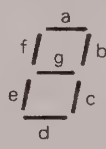
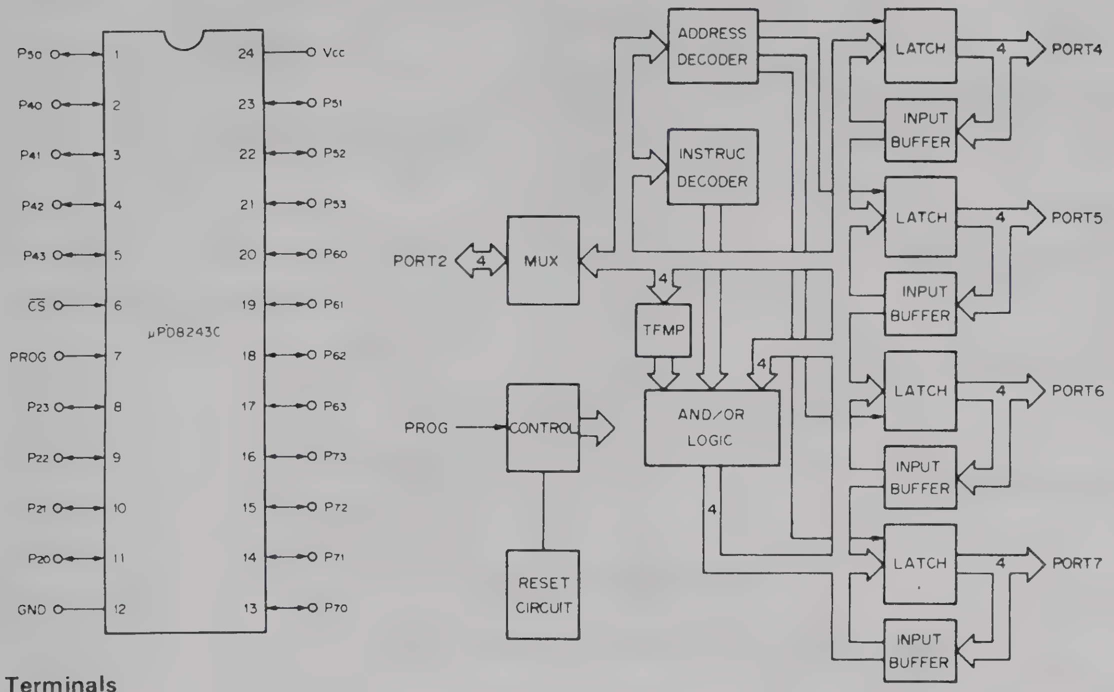
Terminals			Functions
No.		Name	
⑩	1	PL6	PLL DATA for 500kHz comparison.
	2	PL7	
	3	PL5	
⑪	1	AT1	BAND DATA to ANT tuner.
	2	AT2	
	3	AT3	
	4	AT4	
	5	AT0	
	6	LP2	BAND DATA in transmit to the Filter unit.
	7	LP0	
	8	LP1	
	9	RB3	BAND DATA in receive to the Signal unit.
	10	RB2	
	11	RB0	
	12	RB1	
⑫	1	G	GND
	2	PLL1	Serial division data for PLL1 10Hz steps.
	3	G	GND
	4	CK	Clock signal.
	5	G	GND
	6	PLL2	Serial division data for PLL2 2kHz steps.
	7	G	GND
	8	EN	Division data store signal for PLL IC, data is shifted at "H".
⑬	1	—	Not used.
	2	VFO A	Indicator.
	3	ON	
	4	LOCK	
	5	P2	DATA for analog digit.
	6	P3	
	7	P4	
	8	P1	
	9	P9	
	10	P10	
⑭	1	g	
	2	DP	Dot "•" 
	3	P5	DATA for analog digit.
	4	P6	
	5	P7	
	6	P8	
	7	SK	
	8	G1	GRID DATA.
	9	G2	
	10	G3	
	11	G4	
⑮	1	G5	GRID DATA.
	2	G6	
	3	G7	
	4	G8	
	5	G9	
	6	G10	
	7	FH	Heater for Display tube.
	8	FG	
⑯	1	b	
	2	c	
	3	d	
	4	a	
	5	e	
	6	f	
	7	MEMO	MEMO indicator.
	8	VFO B	VFO B indicator.

Table 3 Digital unit terminal function

CIRCUIT DESCRIPTION


P50 1
P40 2
P41 3
P42 4
P43 5
CS 6
PROG 7
P23 8
P22 9
P21 10
P20 11
GND 12
24 Vcc
23 P51
22 P52
21 P53
20 P60
19 P61
18 P62
17 P63
16 P73
15 P72
14 P71
13 P70
µPD8243C
PORT2
4
MUX
ADDRESS DECODER
INSTRUC DECODER
TEMP
AND/OR LOGIC
PROG
CONTROL
RESET CIRCUIT
LATCH
INPUT BUFFER
PORT4
PORT5
PORT6
PORT7

Terminals

P_{20}～P_{23}	: Input Output (Port 2)
P_{40}～P_{43}	: Input Output port (Port 4)
P_{50}～P_{53}	: Input Output port (Port 5)
P_{60}～P_{63}	: Input Output port (Port 6)
P_{70}～P_{73}	: Input Output port (Port 7)
$\overline{CS}$	: Chip Select
PROG	: Program pulse Input Output port (Port 2)

Maximum Rating (Ta=25°C)

Item	Symbol	Rating
Operating voltage	Vcc	−0.5～+7V
Input voltage	Vi	−0.5～+7V
Output voltage	Vo	−0.5～+7V
Operating temperature	Topt	0～+70°C
Storage temperature	Tstg	−60～+150°C

Fig. 5 µPD8243C (Digital unit IC5)

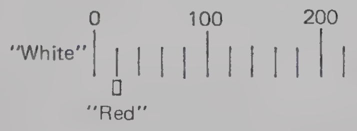
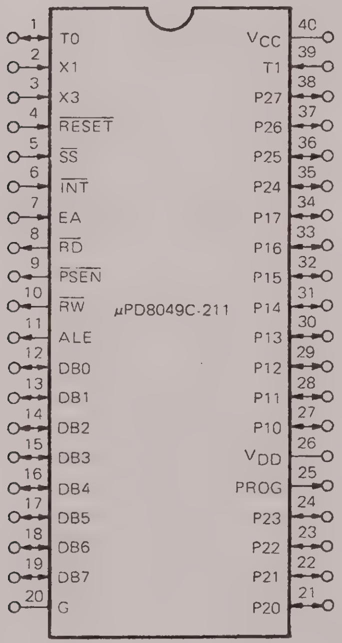
Pin No.	Name	Functions				
13	P70	G2	Digit output			
14	P71	G1				
15	P72	H		H	Scale DATA output	L
16	P73	H		L		H
2	P40	e		P9		VFO B
3	P41	f		P10		MEMO
4	P42	g				
5	P43	Dp	Segment DATA		Scale DATA	
1	P50	a		P1	 0 100 200 "White" "Red"	(–)
23	P51	b		P2		LOCK
22	P52	c		P3		RIT
21	P53	d		P4		VFO A
20	P60			P5		
19	P61			P6		
18	P62			P7		
17	P63			P8		

Table 4

CIRCUIT DESCRIPTION

Terminals		Functions	Terminals		Functions
No.	Name		No.	Name	
1	T0	RIT encoder clock signal, count at "L".	21	P20	I/O Expander control output.
2	X1	Xtal input	22	P21	
3	X3		23	P22	
4	—		24	P23	
5	$\overline{SS}$	Single step.	25	PROG	
6	$\overline{INT}$	Interrupt.	26	VDD	5V
7	EA	External access. Nomally GND.	27	P10	Digit output.
8	$\overline{RD}$	Read	28	P11	
9	—		29	P12	
10	$\overline{RW}$	Read/Write	30	P13	
11	ALE	Address latch enable.	31	P14	
12	DB0	External Data bus.	32	P15	
13	DB1		33	P16	
14	DB2		34	P17	
15	DB3		35	P24	Enable data for PLL.
16	DB4		36	P25	Tone output.
17	DB5		37	P26	Blanking output.
18	DB6		38	P27	TX-stop signal output.
19	DB7		39	T1	Main encoder clock signal, count at "L".
20	G	GND	40	VCC	5V

Table 5 Functions of μPD8049C-211 (Digital unit IC6)


μPD8049C-211
1 T0
2 X1
3 X3
4 RESET
5 SS
6 INT
7 EA
8 RD
9 PSEN
10 RW
11 ALE
12 DB0
13 DB1
14 DB2
15 DB3
16 DB4
17 DB5
18 DB6
19 DB7
20 G
40 VCC
39 T1
38 P27
37 P26
36 P25
35 P24
34 P17
33 P16
32 P15
31 P14
30 P13
29 P12
28 P11
27 P10
26 VDD
25 PROG
24 P23
23 P22
22 P21
21 P20

ACCESSORY CIRCUITS

● Noise blanker in the Signal unit

Fig. 6, 7 shows the noise blanker. The noise blanker consists of two circuits, NB1 and NB2. Noise sampled from the RX 2nd mixer (Q62 and Q63) output transformer is amplified approximately 70dB by Q28 to Q30 and Q32. The amplified noise signal is applied to both NB1 and NB2 circuits. In NB1, the noise is buffered by Q33 and detected by D52 and D53. The detector output is applied to switching transistor Q35. In NB2, the noise is applied directly to the noise detector circuit consisting of D54 to D56 and Q36. NB1 detects pulse noise included in the input signal and switches the noise blanking gate consisting of D82 and D84 to D86, which is located before the RX 2nd IF filter, XF1. The NB1 system is a conventional noise blanker. Noise detected by D54 to D56 and Q36 is shaped by IC2 so that only high level pulse noise components are extracted in the form of a square wave. This square wave is applied to both the switching transistor Q38, to control the 3rd RX mixer (Q65 and Q66), and to the NB gate through D57 and Q31 to switch the gate. The NB2 system is effective against radar-type pulse noise, commonly called "the woodpecker". The noise blankers are also used to reduce clicks generated by the digital VFO step reset pulse.

CIRCUIT DESCRIPTION

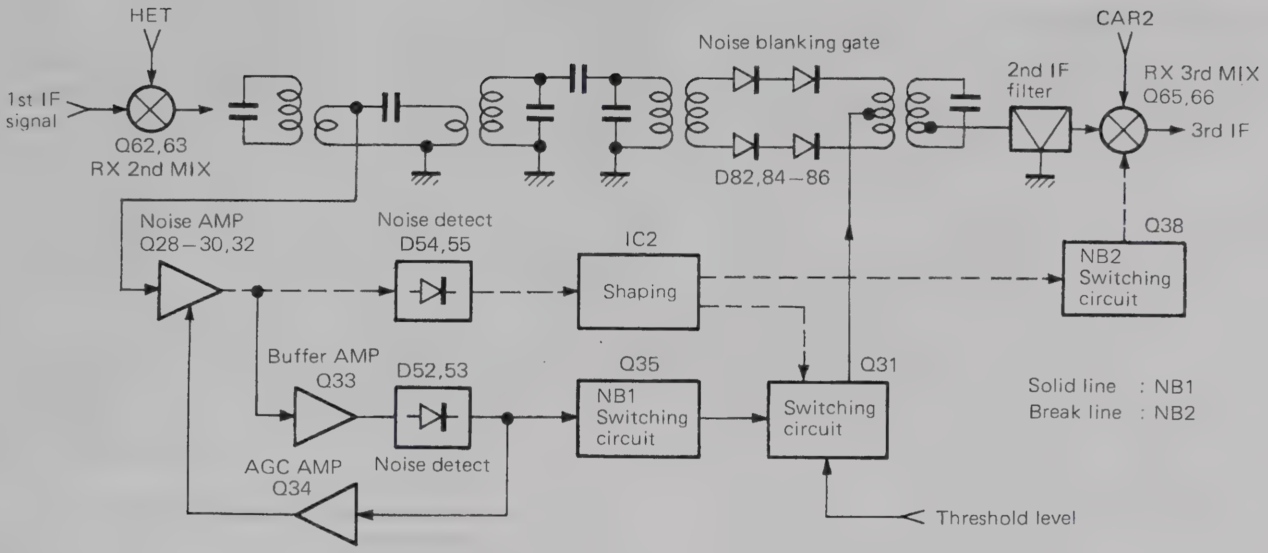

HET
1st IF signal
Q62,63
RX 2nd MIX
Noise blanking gate
D82,84–86
2nd IF filter
CAR2
RX 3rd MIX
Q65,66
3rd IF
Noise AMP
Q28–30,32
Noise detect
D54,55
IC2
Shaping
Q38
NB2 Switching circuit
Buffer AMP
Q33
D52,53
Q35
NB1 Switching circuit
Q31
Switching circuit
Solid line : NB1
Break line : NB2
AGC AMP
Q34
Noise detect
Threshold level

Fig. 6 Noise blanker circuit

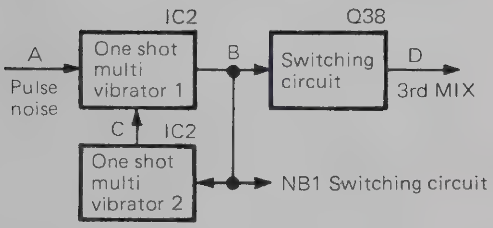

IC2
Q38
A
Pulse noise
One shot multi vibrator 1
B
Switching circuit
D
3rd MIX
C
IC2
One shot multi vibrator 2
NB1 Switching circuit

Fig. 7 NB2 circuit

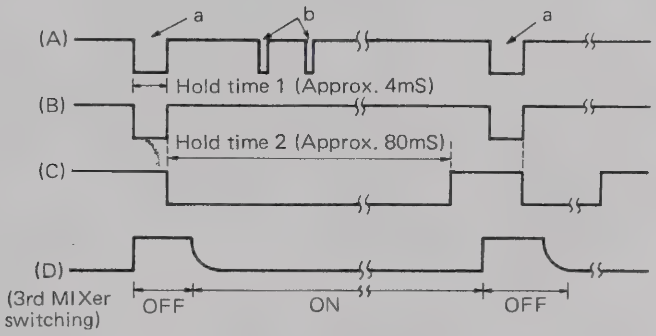


Fig. 8 NB2 timing chart

● Speech processor in the Signal unit

A block diagram of the speech processor is shown in Fig. 9. An SSB signal, having passed 455kHz filter CF1 and buffer Q72, is amplified by Q71 and applied both to the detector consisting of D116 and D117, and to limiting amplifier IC6. The detected signal is applied to DC amplifiers Q73 and Q74, where it is logarithmicly compressed, and is then applied to the multi-meter to indicate compression level. The output level of IC6 is constant regardless of input level. The output signal is applied to gain control amplifier Q70, then input to the TX 1st mixer. When the processor is off, it is bypassed through switching diodes D118 and D114. In the FSK mode, the signal is automatically compressed approximately 10dB (even if the processor switch is off) to equalize any variations in level between mark and space signals. In the FSK mode, the transmission power and ALC are adjusted with the PROC-OUT control.

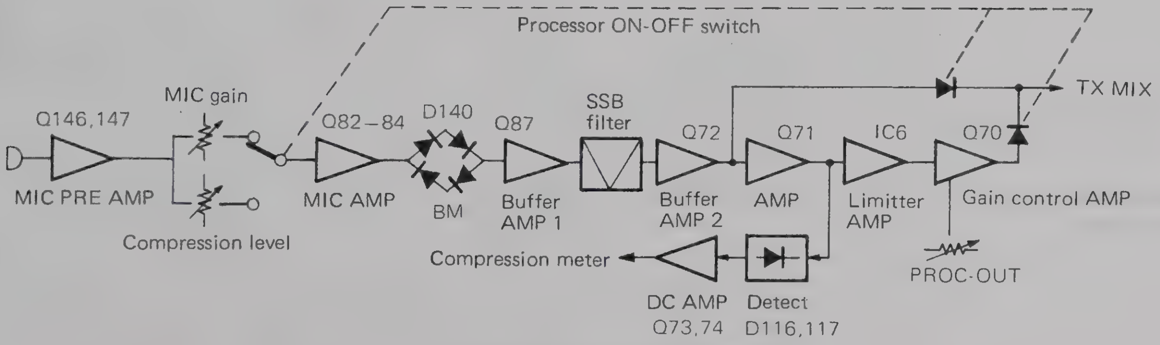

Processor ON-OFF switch
MIC gain
Q146,147
MIC PRE AMP
Compression level
Q82–84
MIC AMP
D140
BM
Q87
Buffer AMP 1
SSB filter
Q72
Buffer AMP 2
Q71
AMP
IC6
Limitter AMP
Q70
Gain control AMP
TX MIX
PROC-OUT
Compression meter
DC AMP
Q73,74
Detect
D116,117

Fig. 9 Speech processor block diagram

CIRCUIT DESCRIPTION

• Monitor circuit in the Signal unit

The SSB signal is sampled from the drain of TX 2nd IF amplifier Q57, is amplified by Q58 and Q125, and then applied to the product detector Q126. The detected AF signal is amplified by Q127, and applied to AF power amplifier IC3.

• Side tone circuit in the Signal unit

The 100kHz CAR 3 signal and 99.2kHz CAR 4 signal are applied to the product detector D238 to D241 to obtain an 800Hz signal. This 800Hz signal is applied to AF power amplifier IC3. Q152 is switched on by the STK line through D233, and side tone is generated when the key is closed. This side tone circuit makes it possible to vary the incoming CW pitch. Signals can be zero-beat by making the side tone pitch the same as that of the CW signal being received.

• SWR calculation circuit in the Signal unit

Conventional SWR indicators require sensitivity adjustment for the forward wave level. The SWR metering circuit incorporated in the TS-930S makes this adjustment automatically. This new SWR calculation circuit is shown in Fig. 10. Forward wave voltage VSF and reflected wave voltage VSR sampled from the Filter unit are applied to the analog calculation circuit in the Signal unit. IC4 is a V-I converter for the (optional) AT-930 auto antenna tuner. Output from IC4 pin 1, proportional to VSR/VSF, drives the SWR meter. IC4 also includes an integrator, IC5 is a voltage comparator, and a triangular wave generator and Q53 and Q54 are switching transistors.

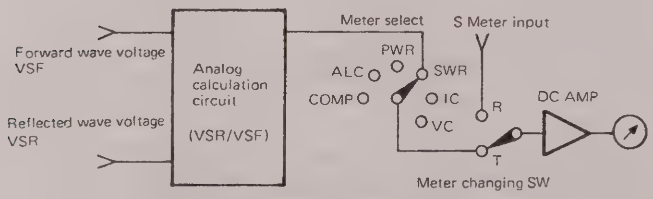


Fig. 10 SWR meter circuit

The VSF voltage is compared with a 0.5V REF voltage on IC4 pin 12. If VSF decreases (i.e. SWR increases) the voltage level at pin 14 increases. The output of IC5 pin 1 is a triangular reference signal and is mixed with the voltage from IC4 pin 14. Changes in the output of IC4 pin 14 affect the reference level of this triangular wave. IC5 computes the change and sends a square wave signal, whose pulse width and spacing are proportional to the change, to control conduction of switching transistors Q53, Q54. See Fig. 11.

The voltage at IC4 pin 1 is a level proportional to VSR/VSF, and is used to drive the SWR meter and also for AT-930 control purposes. VR16 ia an SWR meter adjust for initial setup only.

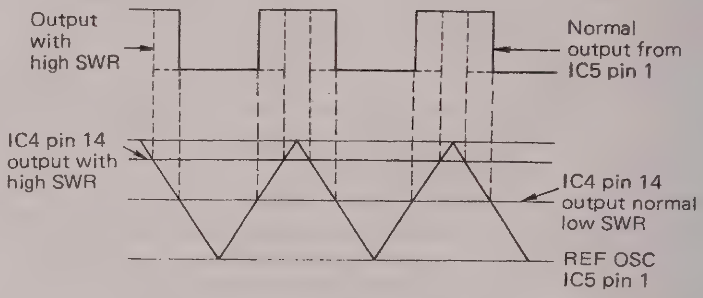

Output with high SWR
Normal output from IC5 pin 1
IC4 pin 14 output with high SWR
IC4 pin 14 output normal low SWR
REF OSC IC5 pin 1

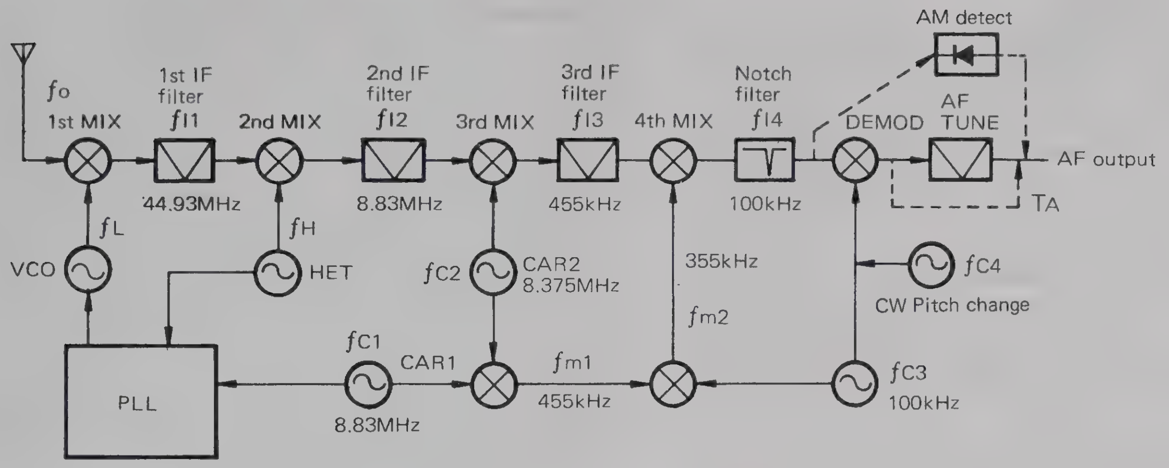
Fig. 11 Automatic SWR computing circuit waveforms

• CW-VBT (variable bandwidth tuning) and SSB-slope-tune in the Signal unit

Fig. 12 shows the CW-VBT and SSB-slope-tune circuits. The principle of CW-VBT operation will be explained first. When CAR 1 and CAR 2 are at their normal frequencies, the overall IF response is indicated by "A". When the CAR 1 frequency is shifted by Δf1, the overall IF response curve shifts to that at "B". The circuit is designed so the CAR 1 signal lowers the VCO frequency fL by Δf1. In this case, the IF bandwidth is fully opened, or normal. Whe the CAR 2 frequency is lowered by Δf2, the 3rd IF filter frequency response curve shifts to that indicated by "C". Thus, the overall IF bandwidth is narrowed. The TS-930S VBT function is designed to operate as : Δf2 = 2Δf1. The overall IF bandwidth is narrowed by varying the CAR 1 and CAR 2 frequencies without shifting the overall IF response center frequency.

Next, the SSB-slope-tune function will be explained. When the circuit is designed so that variations in the CAR 1 and CAR 2 frequencies have the relationship Δf1 = Δf2, only the lower frequency (at the left limit of the overall IF reaponse curve, shown in Fig. 13) can be shifted by varying these frequencies. The higher frequency (at the right limit) can be shifted by varying just the CAR 2 frequency. In the TS-930S, these two operations are performed by separate controls. The CAR 1 frequency control voltage VF1 and CAR 2 control voltege VF2 are supplied from the Switch unit.

CIRCUIT DESCRIPTION


AM detect
fo
1st MIX
1st IF filter
fI1
44.93MHz
2nd MIX
2nd IF filter
fI2
8.83MHz
3rd MIX
3rd IF filter
fI3
455kHz
4th MIX
Notch filter
fI4
100kHz
DEMOD
AF TUNE
AF output
TA
fL
VCO
fH
HET
fC2
CAR2
8.375MHz
355kHz
fm2
fC4
CW Pitch change
PLL
fC1
CAR1
8.83MHz
fm1
455kHz
fC3
100kHz

$$\begin{cases} f_L = f_H + f_{C1} + f_R \\ f_{m2} = f_{C1} - f_{C2} - f_{C3} \\ f_{C4} = f_{C3} - \Delta f_P \end{cases}$$

f_R : Dial displayed frequency

f_O : CAR frequency (SSB, AM, CW)

∴ Tuning point : $f_R = f_O$

$$\begin{cases} f_{I1} = f_L - f_O & \rightarrow\text{: Tuning time} \\ f_{I2} = f_{I1} - f_H = f_R - f_O + f_{C1} & \rightarrow f_{C1} \\ f_{I3} = f_{I2} - f_{C2} = f_R - f_O + f_{C1} - f_{C2} & \rightarrow f_{C1} - f_{C2} \\ f_{I4} = f_{I3} - f_{m2} = f_R - f_O + f_{C3} & \rightarrow f_{C3} \\ f_A = \left| f_{I4} - f_{C3} \right| = \left| f_R - f_O \right| & \rightarrow 0\text{ ; SSB, FSK, TUN} \\ f_A = \left| f_{I4} - f_{C4} \right| = \Delta f_P & \rightarrow \text{CW} \end{cases}$$

Fig. 12-A RX configuration Normal (wide) response

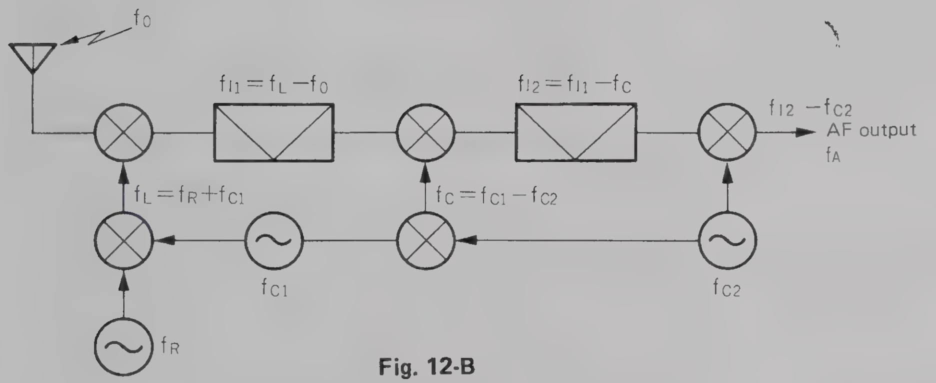

f0
fI1 = fL − f0
fI2 = fI1 − fC
fI2 − fC2
AF output
fA
fL = fR + fC1
fC = fC1 − fC2
fC1
fC2
fR

Fig. 12-B

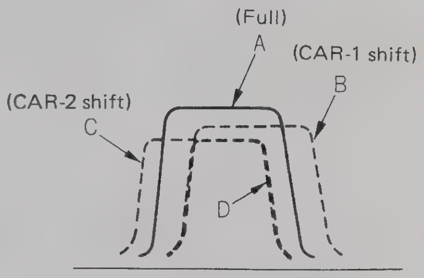


Fig. 12-C CAR-2 shifted

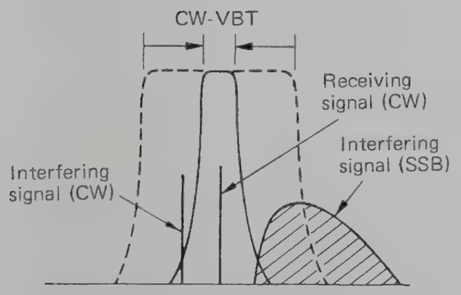


Fig. 12-D CW-VBT

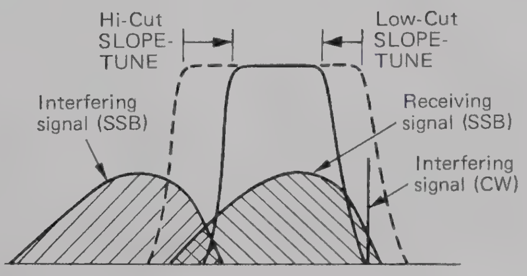


Fig. 12-E SSB-slope-tune

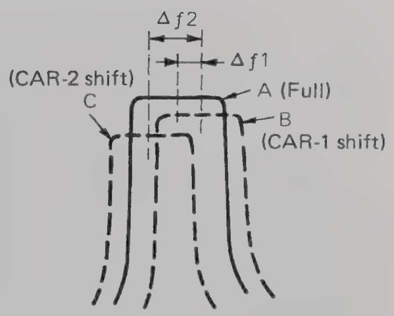


Fig. 13 VCO to bandwidth relationship

CIRCUIT DESCRIPTION

● Notch filter in the Signal unit

The notch filter is a bridged-T filter consisting of L, C and R components. It is located between the 4th RX mixer and the 100kHz IF amplifier Q130. The filter resonant frequency is shifted by varying the voltage applied to the cathode of vari-cap diode D217. The filter operates in all modes.

● AF-tune in the Signal unit

The AF-tune circuit is three-pole active filter built around IC7, located between the SSB/CW detector and AF amplifier Q160. AF-tune is available only in the CW mode. The tuning range is 800Hz ± 400Hz, or greater. When the AF-tune circuit is switched off, the circuit is bypassed through D248.

● VOX and ANTI-VOX circuits in the Signal unit

Fig. 14 shows the VOX and ANTI-VOX circuits. The signal output by MIC preamplifier Q146 is applied to VOX amplifier Q145 through the VOX gain control. The AF output, sampled from the speaker line, is applied to the ANTI-VOX amplifiers Q149 and Q148. An adjustable DC bias voltage is applied to the base of Q148 to control the ANTI-VOX operating level. The digital signals output from these amplifiers are applied to the RS flip-flop IC10. The signal which is first input to the flip-flop has priority. Output from the flip-flop is applied to one-shot multivibrator IC9, and its output is applied to time constant circuit C449 and R567, which determines the VOX delay. This circuit configuration affords fast VOX rise time, and prevents VOX "chatter".

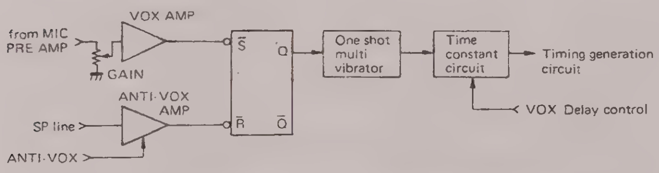

VOX AMP
from MIC PRE AMP
GAIN
ANTI-VOX AMP
SP line
ANTI-VOX
S
Q
R
Q̄
One shot multi vibrator
Time constant circuit
Timing generation circuit
VOX Delay control

Fig. 14 VOX, ANTI-VOX circuit configuration

● Final cooling fan control circuit in the Filter unit

The final heat sink temperature is detected through thermistor TH1 on the Final unit. When the temperature reaches approximately 50°C, a Schmitt circuit, consisting of Q16 and Q17, operates to turn Q22 on. Then, approximately 10V is supplied to the fan motor through the MOT terminal, as Zener D12 is cut off by D10 and Q19. This Schmitt circuit is designed to shut off when the temperature drops to about 45°C.

● Temperature protection circuit in the Filter unit

This circuit also uses the signal from thermistor TH1 on the Final unit. When the final heat sink temperature reaches approximately 75 – 80°C, another Schmitt circuit, consisting of Q18 and Q19, operates. The collector of Q19 goes H, Q23 is turned on and D10 is cut off. Therefore, the voltages of both Zener diodes D11 and D12 are added ; 13V is now applied to the fan motor through the MOT terminal. Thus, the fan motor speeds-up to cool the heat sink rapidly. Simultaneously, the H logic level at Q19 collector is sent to the Signal unit through the THP terminal to switch the transceiver from transmission to reception. This circuit is reset and transmission is re-enabled when the temperature drops below 65 – 70°C (nominal). After reset, the fan continues to operate until the final heat sink temperature drops below about 45°C. (See Fig. 15.)

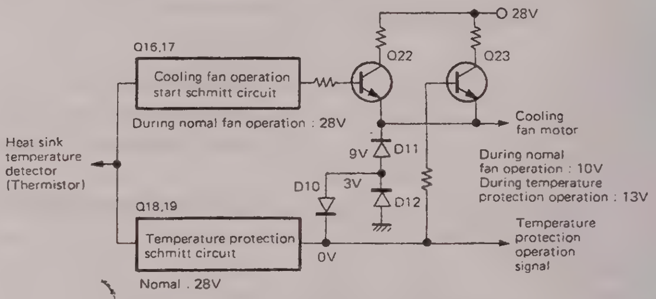

28V
Q16,17
Q22
Q23
Cooling fan operation start schmitt circuit
During nomal fan operation : 28V
Cooling fan motor
Heat sink temperature detector (Thermistor)
9V
D11
D10
3V
D12
During nomal fan operation : 10V
During temperature protection operation : 13V
Q18,19
Temperature protection schmitt circuit
0V
Temperature protection operation signal
Nomal . 28V

Fig. 15 Fan, temperature protection (Final amps)

● Power supply cooling fan control circuit in the Power supply unit

This circuit monitors the power supply heat sink temperature through thermistor TH1. Its operation is similar to the Final unit fan control circuit, previously discussed. It turns the fan on when the power supply heat sink temperature reaches about 60°C and turns off when the temperature drops below about 50°C.

● CW full break-in timing circuit in the Signal unit

Fig. 16 is the timing chart for CW full break-in and send-receive switching in the SSB, FSK and TUNE modes. The TS-930S uses TV, RV, TR, TBK and ALC as timing signals for T-R switching. TV and RV are the power supply voltages for the send and receive systems. About 3ms of quiscent time is provided for both TV and RV at each send-receive switching transition. The operating state is passed to the PLL unit by the TR signal for frequency control during RIT or split frequency operation. TV goes "L" about 6ms after TBK goes "L". During this 6ms period, the TX RF power drops together with the ALC voltage. TB is the bias voltage for the send system and RB is that for the receive system. TB and TV are switched simultaneously. RB is on when TB is off, and vice versa. Fig. 17 shows the timing for CW semi-break-in and for CW keying after the standby switch has been placed to SEND. Note : Omitted signals (such as RV and TR) are the same as shown in Fig. 16.

CIRCUIT DESCRIPTION

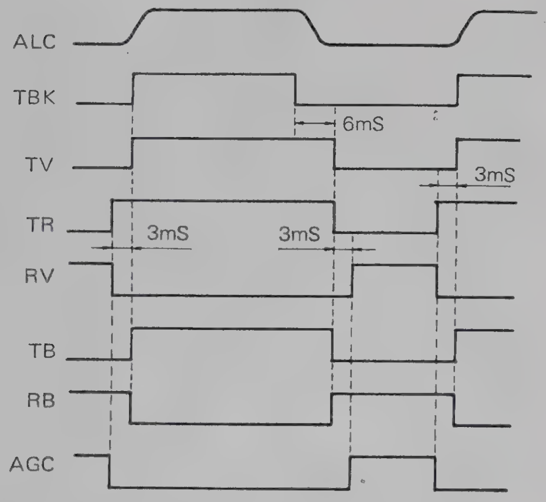


Fig. 16 T-R timing chart
(CW full break-in, SSB, FSK and TUNE modes)

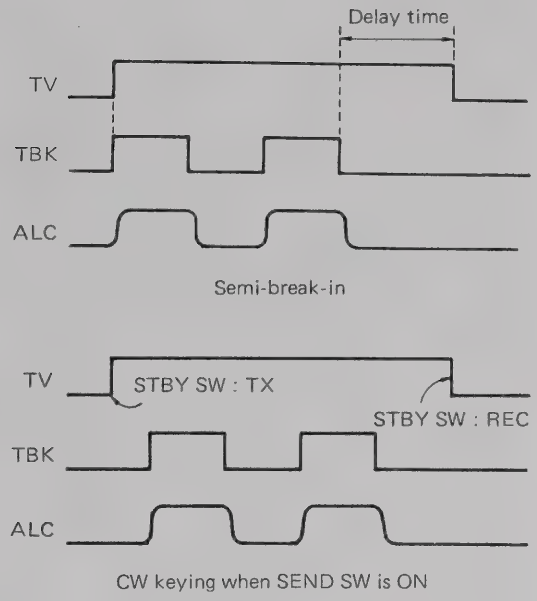


Fig. 17 CW operation timing chart

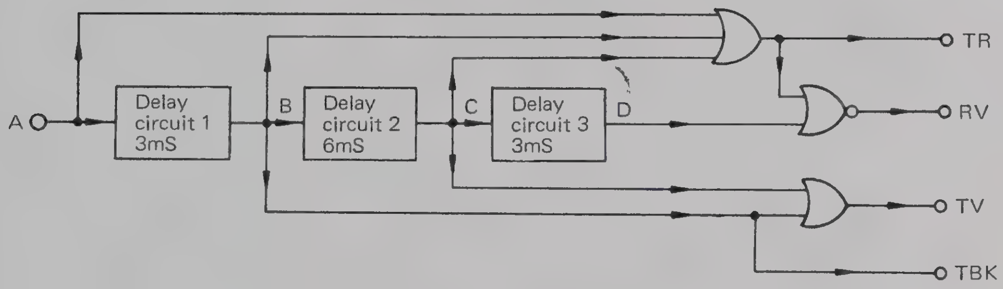

A
Delay circuit 1 3mS
B
Delay circuit 2 6mS
C
Delay circuit 3 3mS
D
TR
RV
TV
TBK

Fig. 18 Timing circuit block diagram

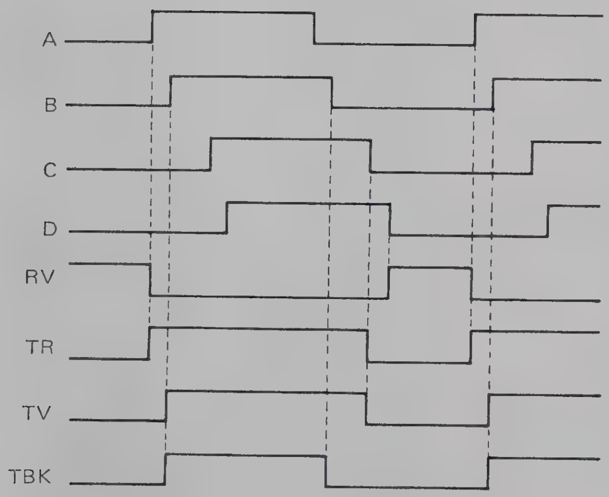


Fig. 19

REFERENCE DATA

SSB, VOX

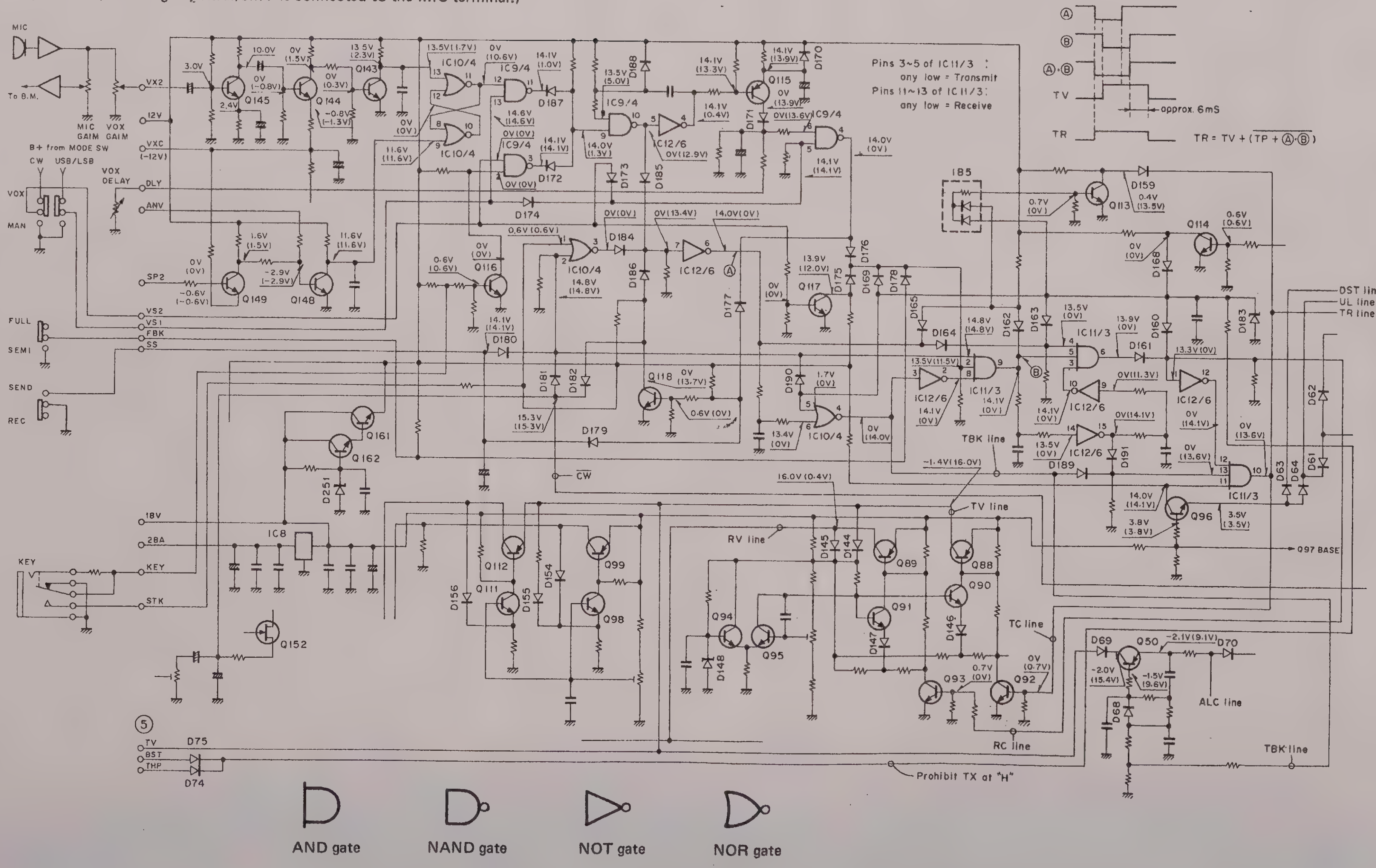
Voltage measurement conditions

f = 14.175.0MHz MODE : SSB VOX/MAN : VOX MIC CONTROL : Centered

VOX GAIN : Centered STBY : REC MIC INPUT : 1kHz/5mV

( ) : in TX (Audio signal, 1kHz/5mV is connected to the MIC terminal.)

Note: In SSB and with the standby switch in the "SEND" position, a low is felt then D179 to turn off Q118. This applies a "H" to IC12/6 pin No.7. IC10/4 is not used when the "SEND" switch is.


MIC
To B.M.
MIC GAIM
VOX GAIM
B+ from MODE SW
CW USB/LSB
VOX DELAY
VOX
MAN
FULL
SEMI
SEND
REC
KEY
VX2
12V
VXC (-12V)
DLY
ANV
SP2
VS2
VS1
FBK
SS
18V
28A
KEY
STK
⑤
TV
BST
THP
D75
D74
Q145
Q144
Q143
Q149
Q148
Q116
Q115
Q117
Q118
Q113
Q114
Q161
Q162
Q152
Q112
Q111
Q99
Q98
Q94
Q95
Q89
Q88
Q90
Q91
Q93
Q92
Q96
Q50
IC8
IC10/4
IC9/4
IC12/6
IC11/3
185
D251
D156
D155
D154
D148
D147
D146
D145
D144
D187
D172
D174
D173
D185
D186
D184
D188
D171
D170
D177
D176
D175
D169
D178
D165
D164
D162
D163
D159
D168
D160
D161
D183
D190
D189
D191
D179
D180
D181
D182
D63
D64
D61
D62
D69
D68
D70
Pins 3~5 of IC11/3 : any low = Transmit
Pins 11~13 of IC11/3: any low = Receive
Ⓐ
Ⓑ
Ⓐ·Ⓑ
TV
TR
approx. 6mS
TR = TV + (TP + Ⓐ·Ⓑ)
CW
TBK line
TV line
RV line
TC line
RC line
ALC line
DST line
UL line
TR line
Q97 BASE
Prohibit TX at "H"
AND gate
NAND gate
NOT gate
NOR gate

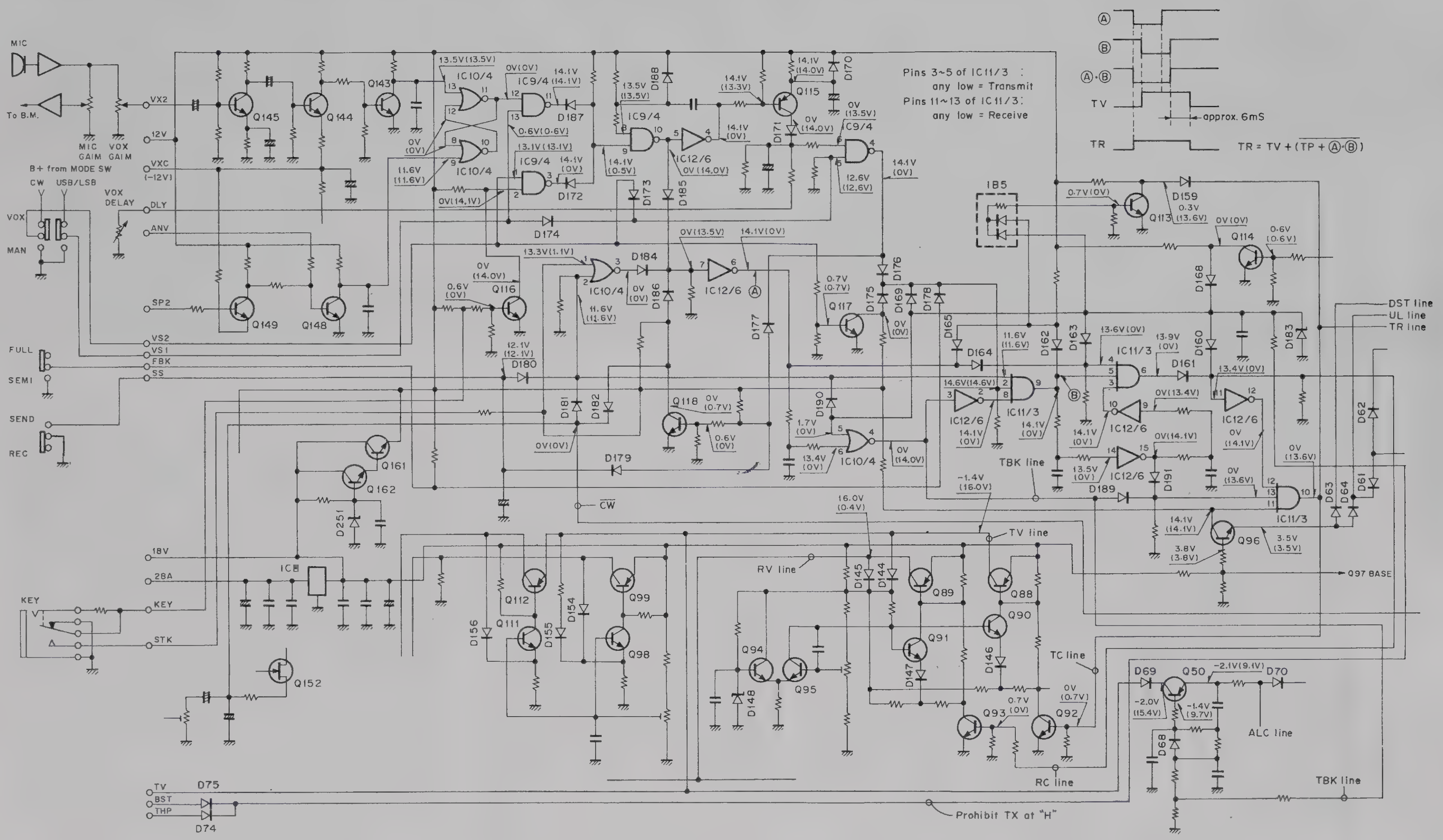
REFERENCE DATA

CW FULL BRAKE IN

Voltage measurement conditions

f = 14.175.0MHz MODE : CW VOX/MAN : VOX FULL/SEMI : FULL CAR CONTROL : MIN STBY : REC

KEY OPEN (in RX) ( ) : KEY CLOSED (in TX)


MIC
To B.M.
MIC GAIM
VOX GAIM
B+ from MODE SW
CW
USB/LSB
VOX DELAY
VOX
MAN
FULL
SEMI
SEND
REC
KEY
VX2
12V
VXC (−12V)
DLY
ANV
SP2
VS2
VS1
FBK
SS
18V
28A
KEY
STK
TV
BST
THP
D75
D74
Q145
Q144
Q143
Q149
Q148
Q116
Q115
Q117
Q118
Q161
Q162
Q152
D251
IC8
IC10/4
IC9/4
IC12/6
IC11/3
D187
D172
D174
D188
D173
D185
D184
D186
D180
D181
D182
D179
D177
D171
D170
D175
D176
D169
D178
D190
D165
D164
D162
D163
D160
D161
D168
D183
D159
D189
D191
D62
D61
D63
D64
IB5
Q113
Q114
Q96
Q112
Q111
Q99
Q98
D156
D155
D154
Q89
Q88
Q90
Q91
Q94
Q95
Q92
Q93
D145
D144
D146
D147
D148
Q50
D69
D70
D68
CW
Ⓐ
Ⓑ
13.5V(13.5V)
0V(0V)
14.1V (14.1V)
13.5V (13.5V)
0.6V(0.6V)
13.1V(13.1V)
14.1V (0V)
11.6V (11.6V)
0V(14.1V)
14.1V (0.5V)
14.1V (0V)
0V (14.0V)
14.1V (13.3V)
14.1V (14.0V)
0V (13.5V)
12.6V (12.6V)
13.3V(1.1V)
0V(13.5V)
14.1V(0V)
0V (14.0V)
0.6V (0V)
12.1V (12.1V)
0V (0V)
11.6V (11.6V)
0V(0V)
0V (0.7V)
0.6V (0V)
0.7V (0.7V)
1.7V (0V)
13.4V (0V)
0V (14.0V)
16.0V (0.4V)
−1.4V (16.0V)
14.6V(14.6V)
14.1V (0V)
11.6V (11.6V)
13.6V(0V)
13.9V (0V)
0V(13.4V)
13.4V(0V)
0V(14.1V)
13.5V (0V)
0V (14.1V)
0V (13.6V)
14.1V (14.1V)
3.8V (3.8V)
3.5V (3.5V)
0.7V(0V)
0.3V (13.6V)
0V(0V)
0.6V (0.6V)
0V (0.7V)
0.7V (0V)
−2.1V(9.1V)
−2.0V (15.4V)
−1.4V (9.7V)
DST line
UL line
TR line
TBK line
TV line
RV line
TC line
RC line
ALC line
TBK line
Q97 BASE
Prohibit TX at "H"
Ⓐ
Ⓑ
Ⓐ·Ⓑ
TV
TR
approx. 6mS
TR = TV + (TP + Ⓐ·Ⓑ)

Pins 3~5 of IC11/3 : any low = Transmit
Pins 11~13 of IC11/3: any low = Receive

CIRCUIT DESCRIPTION

• ALC circuit in the Signal unit

For all modes, except CW full break-in, forward wave voltage VSF detected in the Filter unit is applied to the base of Q45 in the Signal unit. Q45 and Q44 form a differential amplifier. When VSF is applied, the collector voltage of Q44 rises and that of Q47 drops. The gate voltage of Q52 then drops, as do the base and emitter voltages of Q51. As a result, the ALC line voltage is dropped through D70 and Q51 to control transmitter power. The level at the drain of Q52 is applied to the ALC meter. VR11 is the 0 adjustment, and VR12 is the sensitivity adjustment. For full break-in operation, the TBK signal generated during keying is applied to active low pass filter Q50, where key clicks are removed. This filtered signal is used as the ALC signal and is fed to the ALC line. As previously shown, the ALC voltage not only controls transmission power, but is also used for waveform shaping during CW operation.

• VSWR protection circuit in the Signal unit

Reflected wave voltage VSR is applied to the base of Q48 in the Signal unit. When the reflected power exceeds 25W (an SWR of about 3 : 1), Q48 is turned on and the voltage input to the ALC circuit is dropped to reduce transmission power.

• Final overcurrent protection circuit in the Signal unit

Current flowing through the Final unit 28V line is detected across R14 (0.05Ω). The voltage drop across R14 is amplified by IC4/4 and applied to Q49. When current exceeds approximately 15A, Q49 is turned on and the voltage input to the ALC circuit is dropped to reduce the transmission power.

ANTENNA TUNER

A block diagram of the antenna tuner is shown in Fig. 20. This antenna tuner covers all amateur bands from 3.5 through 29MHz. When the operating frequency is within a 500kHz band segment which includes an amateur band (except the 1.8MHz band), the automatic antenna tuner will operate if the AUTO-THRU switch is set to AUTO. When the operating frequency is at any other frequency, the tuner is automatically bypassed regardless of the AUTO-THRU switch position.

When the AUTO-THRU switch is set to AUTO, voltages proportional to the antenna line voltage and current are induced across the directional coupler terminals. The directional coupler is a toroidal core transformer having excellent characteristics in the 3.5 to 30.0MHz range.

Voltage proportional to the antenna line current is applied to Q30 pin 9, and voltage proportional to the antenna line voltage is applied to Q30 pin 13. Both voltage signals are shaped by Q30 and applied to phase comparator Q29. The output level of Q29 changes according to the relationship between the phase of the antenna line current and voltage. This signal is applied to buffer Q28 pins 10 and 15. The levels at pins 12 and 13 change according to the input level, and these signals are applied to Q31 and Q32 (which control the motor drive circuit consisting of Q14 through Q19) so that motor M1 turns in either one direction or the other, according to the phase relationship, until the phase difference is minimized.

Voltages picked up by the directional coupler are also applied to Q39 pins 4 and 6 for comparison. When the voltage at pin 6 is higher than that at pin 4, the level at pin 1 is "H" and that at pin 2 is "L" (and vice versa). Motor M2 turns in either one direction or the other, according to these levels. The circuit is designed so that VC1 and VC2 (that is, M1 and M2) operate independently. However, since phase and voltage are not independent, both VC1 and VC2 operate as either phase or voltage varies.

When the input voltages to Q39 become equal, the level at pin 5 (or pin 7) is determined by the divider consisting of R100 and R104 (or R105 and R101) so it is lower than the corresponding input level ; then output levels at both pins 1 and 2 go "L", the motor drive circuit turns off and the motor stops.

A current signal proportional to the SWR is derived by the SWR calculation circuit in the Signal unit, and is input to the Antenna tuner unit through the ISW terminal. This current signal is applied to Q40b pin 2 and converted to a voltage signal. The input level at Q39c pin 8 is set to the level equal to the output level of Q40b when the SWR is 1.2. Therefore, the output level at Q39c pin 14 is "H" when SWR is higher than 1.2. This "H" signal is applied to Q11 so that Q11, Q10 and Q34 are turned on and the motor drive circuits are enabled. When SWR becomes 1.2 or less, the level at Q39c pin 14 goes "L". Therefore, Q11, Q10 and Q34 turn off and the motor drive circuits are disabled.

Generally, the tuning motors should run at high speed to reduce the time required to tune the antenna. If this were done, however, inertia would cause the motor to overrun after the motor stops when the SWR becomes 1.2 or less. This would cause the SWR to again become greater than 1.2, and the motor to operate in reverse. This might repeat infinitely. On the other hand, it requires a longer time to tune the antenna if the motor speed is too slow. The motor control system employed in the AT-930 is as follows. Q41 forms a multivibrator and its output is applied to Q40a pin 6. A signal proportional to the SWR is applied to Q40a pin 5. The signal output by Q40 is a pulse whose width increases as the SWR becomes higher, or vice versa. This pulse signal is applied to Q38, then Q34, so that motor speed increases when the SWR is high and reduces when it is low.

CIRCUIT DESCRIPTION

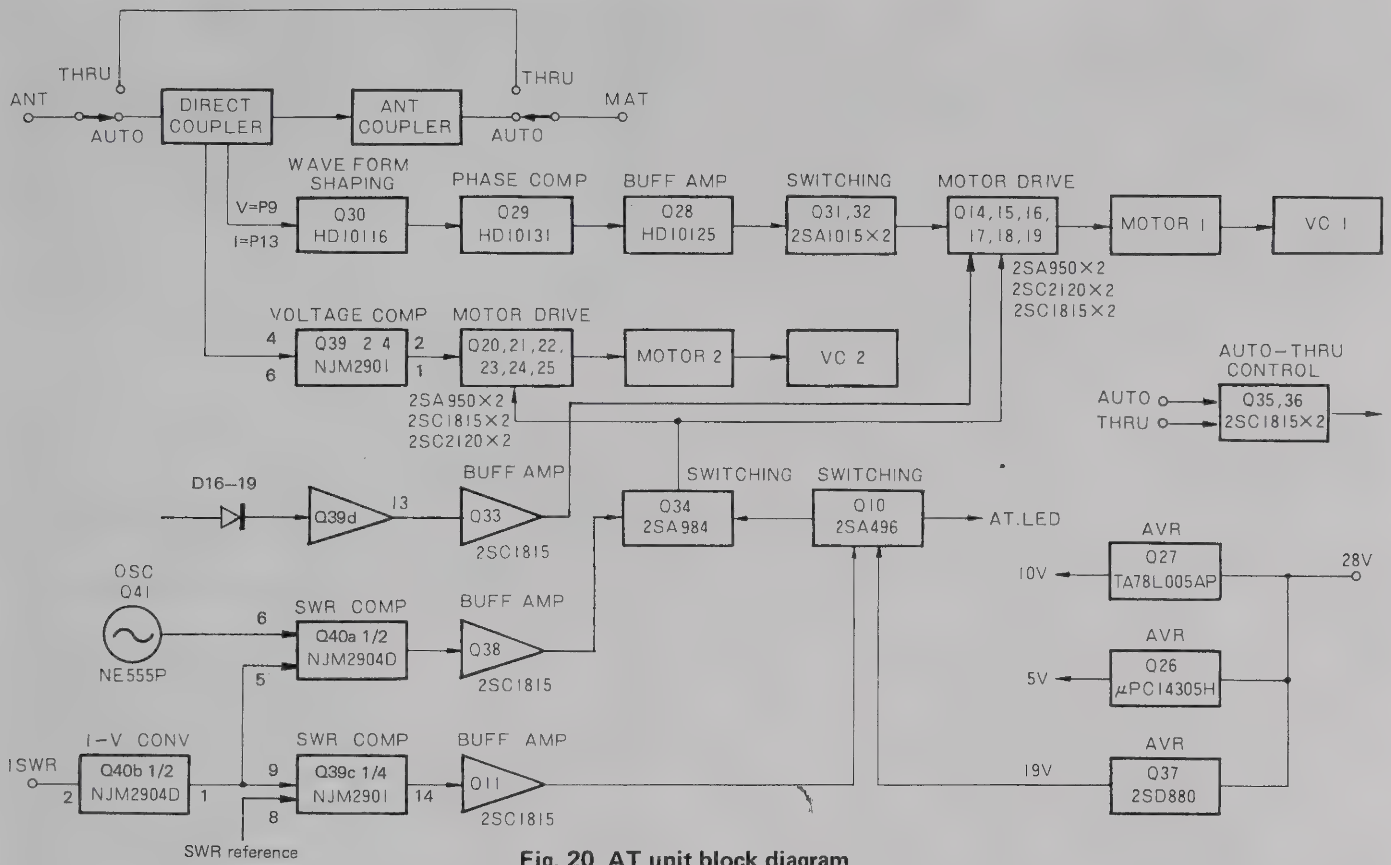

THRU
ANT
AUTO
DIRECT COUPLER
ANT COUPLER
THRU
MAT
AUTO
WAVE FORM SHAPING
V=P9
I=P13
Q30 HD10116
PHASE COMP
Q29 HD10131
BUFF AMP
Q28 HD10125
SWITCHING
Q31,32 2SA1015×2
MOTOR DRIVE
Q14,15,16,17,18,19
2SA950×2
2SC2120×2
2SC1815×2
MOTOR 1
VC 1
VOLTAGE COMP
4
6
Q39 2 4 NJM2901
2
1
MOTOR DRIVE
Q20,21,22,23,24,25
2SA950×2
2SC1815×2
2SC2120×2
MOTOR 2
VC 2
AUTO-THRU CONTROL
AUTO
THRU
Q35,36 2SC1815×2
D16–19
Q39d
13
BUFF AMP
Q33
2SC1815
SWITCHING
Q34 2SA984
SWITCHING
Q10 2SA496
AT.LED
OSC Q41
NE555P
6
5
SWR COMP
Q40a 1/2 NJM2904D
BUFF AMP
Q38
2SC1815
AVR
Q27 TA78L005AP
10V
28V
AVR
Q26 μPC14305H
5V
AVR
Q37 2SD880
19V
I-V CONV
ISWR
2
Q40b 1/2 NJM2904D
1
SWR COMP
9
8
Q39c 1/4 NJM2901
14
BUFF AMP
Q11
2SC1815
SWR reference

Fig. 20 AT unit block diagram

The antenna tuner is provided with a protection circuit which disables the AUTO-THRU switch during transmission. When the AUTO-THRU switch is at THRU, D13 is on, D14 is off and Q36 is off. Q35 is on because a "H" is applied through D15. The "H" at the collector of Q36 is applied to Q8 through D9 and turnes Q8 on. Thus, Q7 is on and relay RL1 is actuated. When the AUTO-THRU switch is at AUTO, D12 is on, so D11 and Q35 are off. The collector level at Q35 is applied to Q36 through D10 so Q36 is on. Therefore, Q36 collector level is "L" and Q8 is off. Thus, Q7 and RL1 are off. During transmission, RXB is "L" and both D12 and D13 are turned off, so the AUTO-THRU switch is disconnected from Q35 and Q36. Therefore, the AUTO-THRU switch has no affect.

The BAND data signals for the 3.5MHz to 29MHz Amateur bands are sent from the Digital unit through terminals AT1 to AT6. (See Table 6.) The AT1 signal is used for automatic antenna tuner control ; its level is "H" when the operating frequency is within a 500kHz Amateur band segment. At such time, Q9 is on and D8 is off. This allows Q8 to be controlled through D9. When the level is "L", Q9 is off and D8 is on. Therefore, the level at the base of Q8 is maintained at "H" through R17. (Q8 is always on ; that is, the tuner is in the THRU state.)

The matching circuit used is a "T" configuration when the operating frequency is between 3.5MHz and 14MHz, and a π configuration when the operating frequency is 18MHz or above. Switching between the two is performed by relay RL8. When the motors are operating, the green LED ingicator on the front panel lights. This indicator goes off when the motors stop at best match.

BAND	AT1	AT2	AT3	AT4	AT5	AT6
3.5	○	○	○	○		
7	○		○	○		
10	○			○		
14	○			○		○
18,21	○					
24.5,28	○				○	

○ : High Level

Table 6

FILTER DATA

Item	Rating
Nominal center frequency	44.930MHz
Pass bandwidth	±6kHz or more at 6dB
Attenuation bandwidth	±25kHz or less at 30dB
Ripple	1.5dB or less
Loss	4dB or less
Guaranteed attenuation	60dB or more within ±1MHz
Input and output impedance	2kΩ ± 10%

MCF (L71-0234-05) (Signal unit XF1,2)

Item	Rating
Nominal center frequency	8830kHz
Center frequency deviation	Within ±150Hz at 6dB
Pass bandwidth	±1.5kHz or more at 6dB
Attenuation bandwidth	±1.9kHz or less at 20dB ±2.75kHz or less at 60dB ±3.5kHz or less at 80dB
Ripple	2dB or less
Loss	6dB or less
Guaranteed attenuation	80dB or more within ±3.5kHz—±1MHz
Input and output impedance	600Ω / 15pF

MCF (L71-0235-05) (Signal unit XF3)

Item	Rating
Nominal center frequency	455kHz
6dB bandwidth	±3kHz or more
50dB bandwidth	±9kHz or less
Ripple (within 455 ± 2kHz)	2dB or less
Loss	6dB or less
Guaranteed attenuation (within 455kHz ± 100kHz)	60dB or more
Input and output impedance	2.0kΩ

AM ceramic filter (L72-0319-05) (Signal unit CF2)

Item	Rating
Center frequency	455 ± 0.20kHz
6dB bandwidth	2.9—3.2kHz
60dB bandwidth	4.7kHz or less
Guaranteed attenuation (0.1—1MHz)	60dB or more
Spurious (600—700kHz)	40dB or more
Ripple	2dB or less
Loss	6dB or less
Input and output impedance	2kΩ

SSB ceramic filter (L72-0334-05) (Signal unit CF1)

Item	Rating
Nominal center frequency	8830.0kHz
Center frequency deviation	Within ±70Hz at 6dB (25°C)
Pass bandwidth	±250Hz or more at 6dB
Attenuation bandwidth	±900Hz or less at 60dB
Guaranteed attenuation	80dB or more within ±2kHz—±1MHz
Ripple	2dB or less
Loss	Within 5dB ± 2dB
Input and output impedance	600Ω / 15pF

CW crystal filter YK-88C-1
(L71-0236-05) Option

Item	Rating
Nominal center frequency	8830.0kHz
Center frequency deviation	Within ±250Hz at 6dB
Pass bandwidth	±3.0kHz or more at 6dB
Attenuation bandwidth	±6kHz or less at 60dB ±10kHz or less at 80dB
Ripple	2dB or less
Loss	Within 3dB ± 2dB
Guaranteed attenuation	80dB or more within ±10kHz—±1MHz
Input and output impedance	600Ω / 15pF

AM crystal filter YK-88A-1
(L71-0237-05) Option

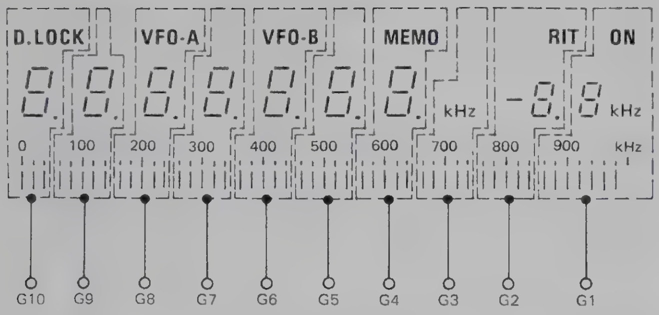
Item	Rating
Center frequency	455kHz
Center frequency deviation	Within 50Hz at 6dB
Pass bandwidth	±250Hz or more at 6dB
Attenuation bandwidth	±425Hz or less at 60dB
Ripple	2dB or less
Loss	6dB or less
Guaranteed attenuation	80dB or more within 100Hz—454.4kHz 80dB or more within 455.6kHz—2MHz
Input and output impedance	2kΩ ± 5% / 15pF ± 5%

CW crystal filter YG-455C-1
(L72-0238-05) Option

Item	Rating
Center frequency	455kHz
Center frequency deviation	Within 50Hz at 6dB
Pass bandwidth	±125Hz or more at 6dB
Attenuation bandwidth	±250Hz or less at 60dB
Ripple	2dB or less
Loss	6dB or less
Guaranteed attenuation	80dB or more within 100Hz— 454.6kHz 80dB or more within 455.4kHz—2MHz
Input and output impedance	2kΩ ± 5% / 15pF ± 5%

CW crystal filter YG-455CN-1
(L72-0239-05) Option

SEMICONDUCTOR DATA

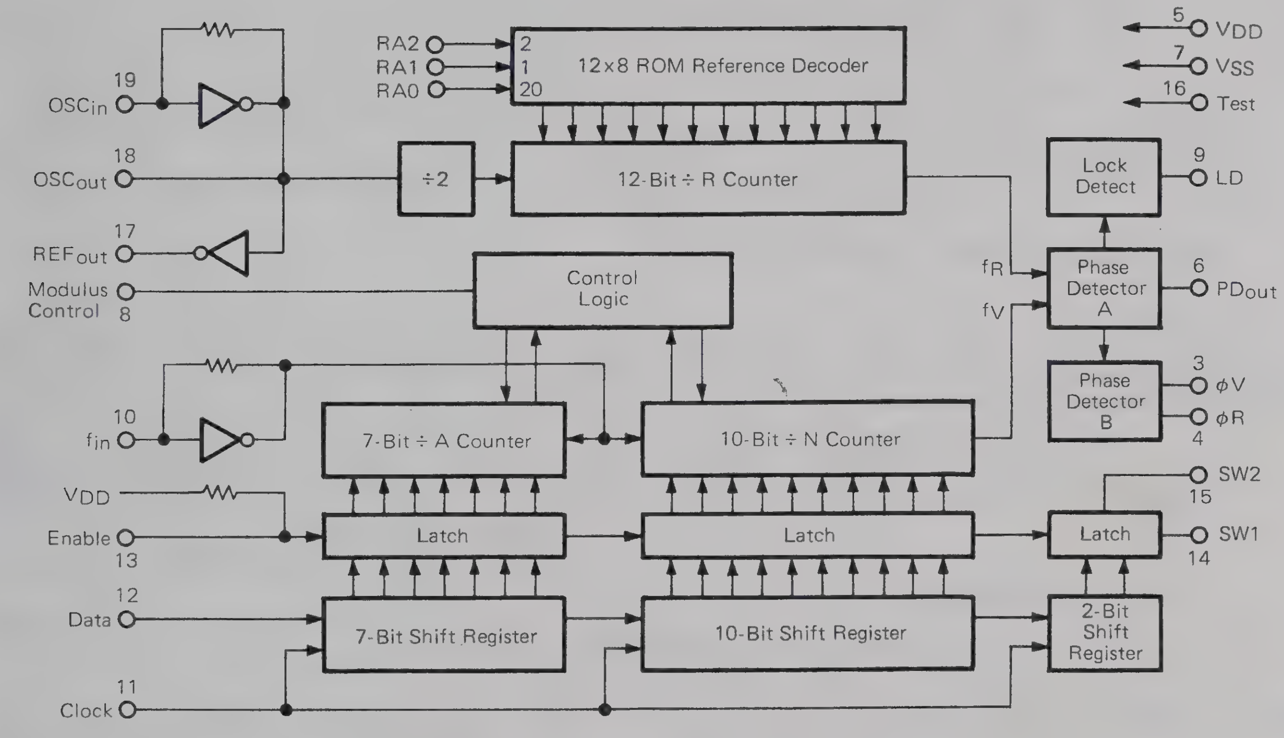

D.LOCK
VFO-A
VFO-B
MEMO
RIT
ON
kHz
kHz
0
100
200
300
400
500
600
700
800
900
kHz
G10
G9
G8
G7
G6
G5
G4
G3
G2
G1

11-BT-03Z (Switch unit V1)

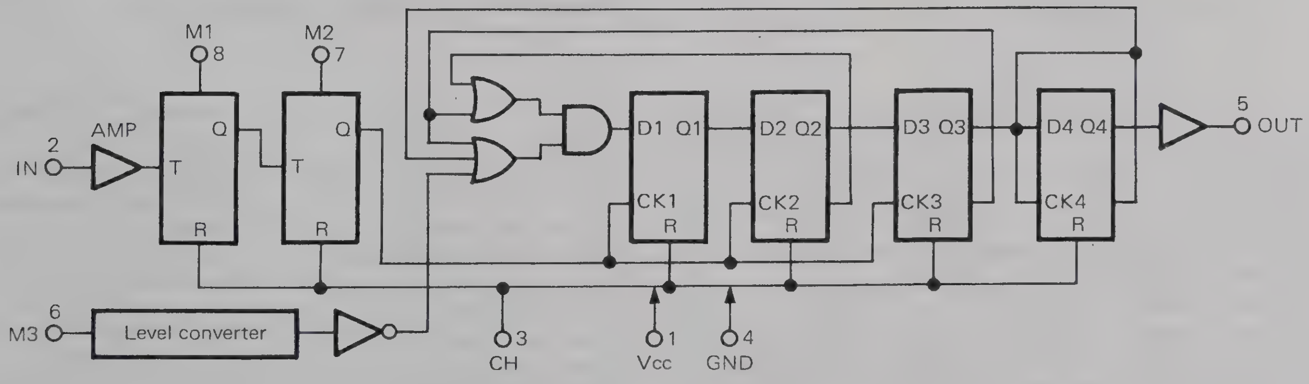
Item	Symbol	Rating
Gate-Drain voltage	V_{CDO}	–25V
Gate-Source voltage	V_{GSO}	–25V
Continuous Drain current	I_D	100mA
Continuous Gate current	I_G	10mA
Power dissipation	Pch	500mW
Channel temperature	Tch	120°C
Storage temperature	Tstg	–50～+120°C

Ta=25°C

2SK125P MAX. Rating (RF unit Q1,2)

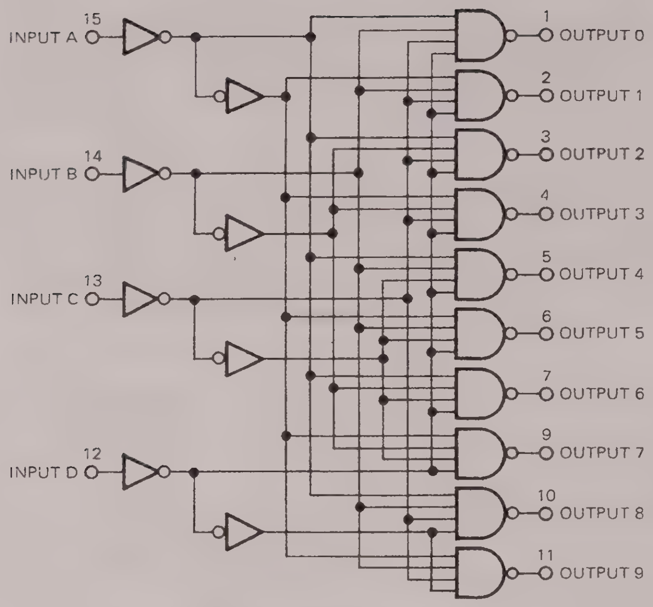

19
OSCin
18
OSCout
17
REFout
Modulus Control 8
RA2
RA1
RA0
2
1
20
12×8 ROM Reference Decoder
÷2
12-Bit ÷ R Counter
Control Logic
10
fin
VDD
Enable
13
12
Data
11
Clock
7-Bit ÷ A Counter
10-Bit ÷ N Counter
Latch
Latch
7-Bit Shift Register
10-Bit Shift Register
fR
fV
5
VDD
7
VSS
16
Test
Lock Detect
9
LD
Phase Detector A
6
PDout
Phase Detector B
3
ϕV
ϕR
4
SW2
15
Latch
SW1
14
2-Bit Shift Register

MC145156P Block diagram (PLL unit IC5)


M1
8
M2
7
2
IN
AMP
T
Q
R
T
Q
R
D1 Q1
CK1
R
D2 Q2
CK2
R
D3 Q3
CK3
R
D4 Q4
CK4
R
5
OUT
6
M3
Level converter
3
CH
1
Vcc
4
GND

μPB551C Block diagram (PLL unit IC8)

SEMICONDUCTOR DATA

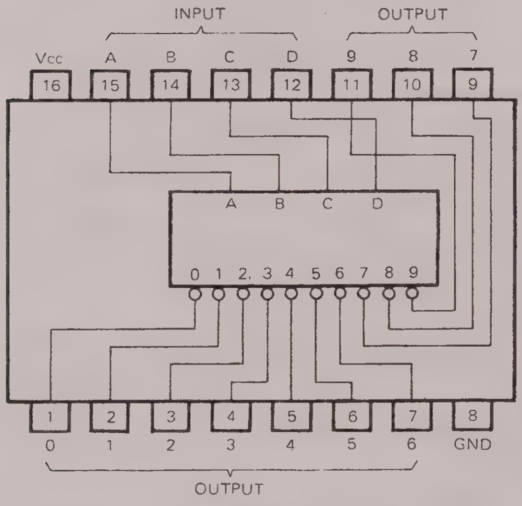

15
INPUT A
14
INPUT B
13
INPUT C
12
INPUT D
1
OUTPUT 0
2
OUTPUT 1
3
OUTPUT 2
4
OUTPUT 3
5
OUTPUT 4
6
OUTPUT 5
7
OUTPUT 6
9
OUTPUT 7
10
OUTPUT 8
11
OUTPUT 9

MB74LS42 Block diagram (LPF unit IC1)

No.	BCD input				Decimal output data									
	D	C	B	A	0	1	2	3	4	5	6	7	8	9
0	L	L	L	L	L	H	H	H	H	H	H	H	H	H
1	L	L	L	H	H	L	H	H	H	H	H	H	H	H
2	L	L	H	L	H	H	L	H	H	H	H	H	H	H
3	L	L	H	H	H	H	H	L	H	H	H	H	H	H
4	L	H	L	L	H	H	H	H	L	H	H	H	H	H
5	L	H	L	H	H	H	H	H	H	L	H	H	H	H
6	L	H	H	L	H	H	H	H	H	H	L	H	H	H
7	L	H	H	H	H	H	H	H	H	H	H	L	H	H
8	H	L	L	L	H	H	H	H	H	H	H	H	L	H
9	H	L	L	H	H	H	H	H	H	H	H	H	H	L
	H	L	H	L	H	H	H	H	H	H	H	H	H	H
	H	L	H	H	H	H	H	H	H	H	H	H	H	H
	H	H	L	L	H	H	H	H	H	H	H	H	H	H
	H	H	L	H	H	H	H	H	H	H	H	H	H	H
	H	H	H	L	H	H	H	H	H	H	H	H	H	H
	H	H	H	H	H	H	H	H	H	H	H	H	H	H

H : High level, L : Low level

MB74LS42 Functions table


INPUT
OUTPUT
Vcc
A
B
C
D
9
8
7
16
15
14
13
12
11
10
9
A
B
C
D
0 1 2 3 4 5 6 7 8 9
1
2
3
4
5
6
7
8
0
1
2
3
4
5
6
GND
OUTPUT

MB74LS42

Item	V_{CBO}	V_{CEO}	V_{EBO}	I_C	icp	Pc	Tj	Tstg
Condition						Tc= 25°C		
Rating	–100V	–80V	–5V	–500mA	–800mA	600mW	150°C	–55~ +150°C

Ta=25°C

2SK984K MAX. Rating
(Digital unit Q1,16, Signal unit Q23)

Item	V_{CBO}	V_{CEO}	V_{EBO}	I_C	icp	Pc	Tj	Tstg
Condition						Tc= 25°C		
Rating	100V	80V	5V	500mA	800mA	600mW	150°C	–55~ +150°C

Ta = 25°C

2SC2274K MAX. Rating (Digital unit Q14,15)

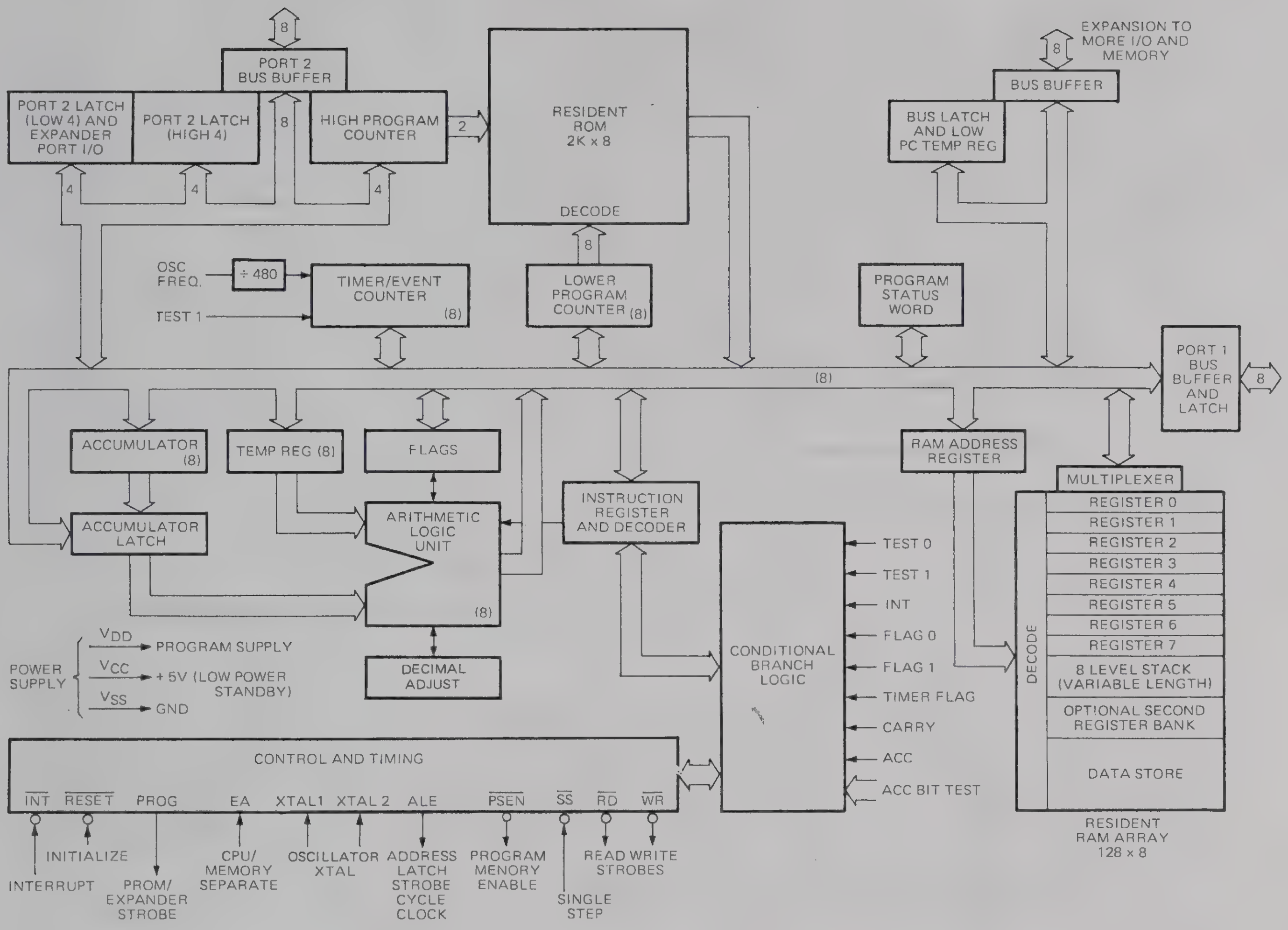
Item	Symbol	Rating
Collector-Emitter voltage	V_{CEO}	35V
Collector-Base voltage	V_{CBO}	65V
Emitter-Base voltage	V_{EBO}	4.0V
Continuous Collector current	I_C	1.0A
Total device dissipation Tc=50°C Derate above 50°C	P_D	30W 0.3W/°C
Storage temperature	Tstg	–65~+150°C

MRF485 MAX. Rating (100W Final unit Q2,3)

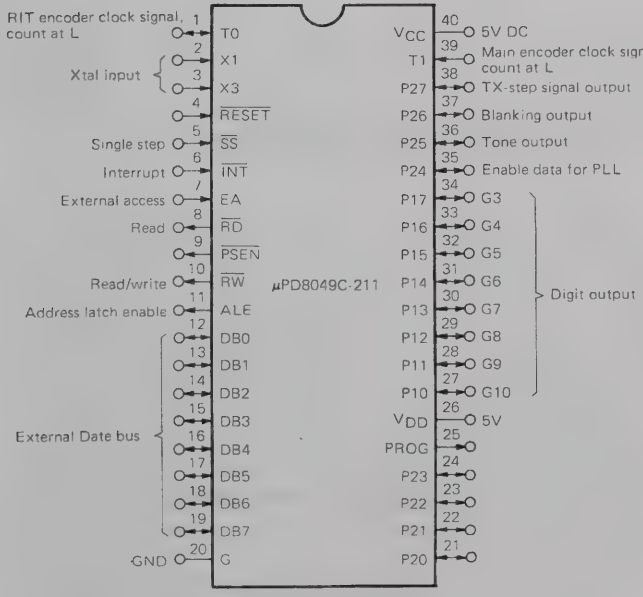
Item	Symbol	Rating
Collector-Emitter voltage	V_{CEO}	40V
Collector-Base voltage	V_{CBO}	85V
Emitter-Base voltage	V_{EBO}	3.0V
Continuous Collector current	I_C	20A
Withstanding current –10s	–	30A
Total device dissipation Tc=25°C Derate above 25°C	P_D	290W 1.66W/°C
Storage temperature	Tstg	–65~+200°C

MRF422 MAX. Rating (100W Final unit Q4,5)

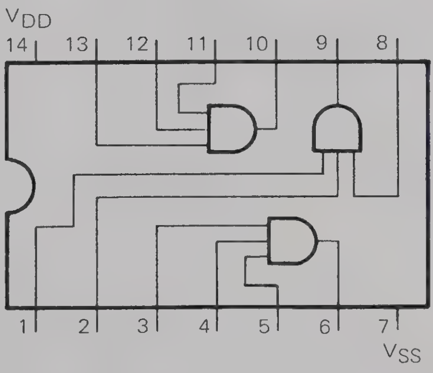
SEMICONDUCTOR DATA


8
PORT 2 BUS BUFFER
PORT 2 LATCH (LOW 4) AND EXPANDER PORT I/O
PORT 2 LATCH (HIGH 4)
8
HIGH PROGRAM COUNTER
2
RESIDENT ROM 2K x 8
DECODE
4
4
4
8
EXPANSION TO MORE I/O AND MEMORY
8
BUS BUFFER
BUS LATCH AND LOW PC TEMP REG
OSC FREQ.
÷ 480
TIMER/EVENT COUNTER (8)
TEST 1
LOWER PROGRAM COUNTER (8)
PROGRAM STATUS WORD
(8)
PORT 1 BUS BUFFER AND LATCH
8
ACCUMULATOR (8)
TEMP REG (8)
FLAGS
ACCUMULATOR LATCH
ARITHMETIC LOGIC UNIT (8)
INSTRUCTION REGISTER AND DECODER
RAM ADDRESS REGISTER
MULTIPLEXER
REGISTER 0
REGISTER 1
REGISTER 2
REGISTER 3
REGISTER 4
REGISTER 5
REGISTER 6
REGISTER 7
8 LEVEL STACK (VARIABLE LENGTH)
OPTIONAL SECOND REGISTER BANK
DATA STORE
DECODE
RESIDENT RAM ARRAY 128 x 8
CONDITIONAL BRANCH LOGIC
TEST 0
TEST 1
INT
FLAG 0
FLAG 1
TIMER FLAG
CARRY
ACC
ACC BIT TEST
POWER SUPPLY
V_{DD} PROGRAM SUPPLY
V_{CC} +5V (LOW POWER STANDBY)
V_{SS} GND
DECIMAL ADJUST
CONTROL AND TIMING
INT
RESET
PROG
EA
XTAL1
XTAL 2
ALE
PSEN
SS
RD
WR
INITIALIZE
INTERRUPT
PROM/ EXPANDER STROBE
CPU/ MEMORY SEPARATE
OSCILLATOR XTAL
ADDRESS LATCH STROBE CYCLE CLOCK
PROGRAM MENORY ENABLE
SINGLE STEP
READ WRITE STROBES

μPD8049C-211 Block diagram (Digital unit IC6)

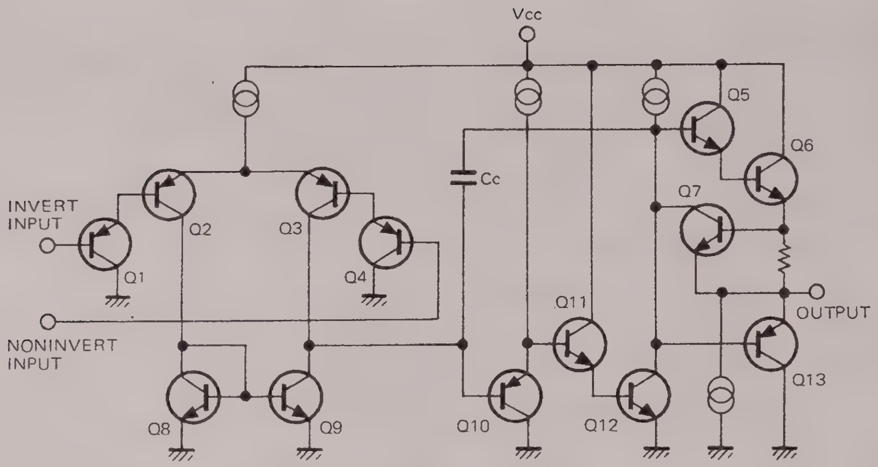

RIT encoder clock signal, count at L
1 T0
Xtal input
2 X1
3 X3
4 RESET
Single step
5 SS
Interrupt
6 INT
External access
7 EA
Read
8 RD
9 PSEN
Read/write
10 RW
Address latch enable
11 ALE
External Date bus
12 DB0
13 DB1
14 DB2
15 DB3
16 DB4
17 DB5
18 DB6
19 DB7
GND
20 G
μPD8049C-211
40 V_{CC} 5V DC
39 T1 Main encoder clock signal, count at L
38 P27 TX-step signal output
37 P26 Blanking output
36 P25 Tone output
35 P24 Enable data for PLL
34 P17 G3
33 P16 G4
32 P15 G5
31 P14 G6
30 P13 G7
29 P12 G8
28 P11 G9
27 P10 G10
Digit output
26 V_{DD} 5V
25 PROG
24 P23
23 P22
22 P21
21 P20

μPD8049C-211

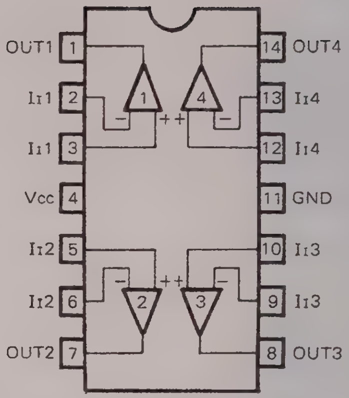

V_{DD}
14
13
12
11
10
9
8
1
2
3
4
5
6
7
V_{SS}

TC4073BP (Signal unit IC11)

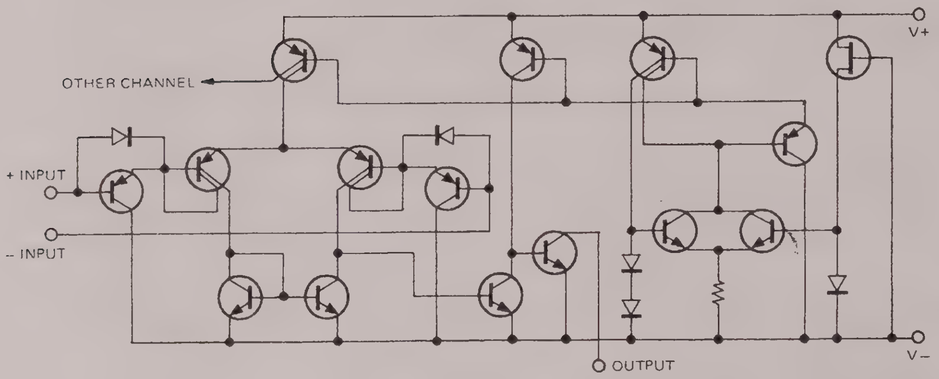
SEMICONDUCTOR DATA


Vcc
Cc
Q5
Q6
Q7
INVERT INPUT
Q1
Q2
Q3
Q4
Q11
OUTPUT
NONINVERT INPUT
Q8
Q9
Q10
Q12
Q13

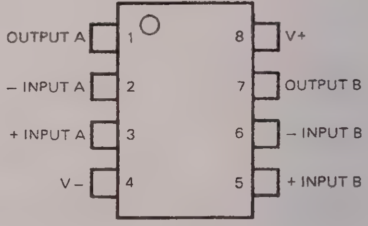
MB3614 Equivalent circuit (Signal unit IC4,7)


OUT1 1
II1 2
II1 3
Vcc 4
II2 5
II2 6
OUT2 7
14 OUT4
13 II4
12 II4
11 GND
10 II3
9 II3
8 OUT3
1
2
3
4

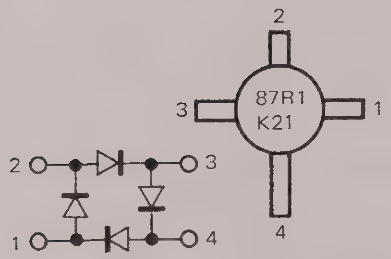
MB3614 (TOP VIEW)


V+
OTHER CHANNEL
+ INPUT
– INPUT
OUTPUT
V–

NJM2903D Equivalent circuit (Signal unit IC5)


OUTPUT A 1
– INPUT A 2
+ INPUT A 3
V– 4
8 V+
7 OUTPUT B
6 – INPUT B
5 + INPUT B

NJM2903D


2
3
1
4
87R1
K21
2
3
1
4

ND487R1-3R (Signal unit D140)

Item	V_{CBO}	V_{CEO}	V_{EBO}	I_C	icp	I_B	Pc	Tj	Tstg
Condition							Tc= 25°C		
Rating	500V	400V	10V	0.5A	1.0A	0.75A	10W	150°C	–55~ +150°C

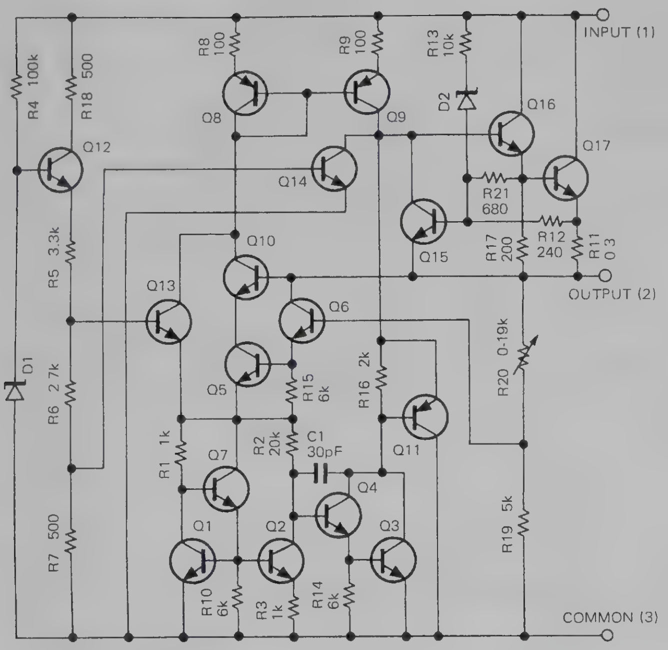
Ta = 25°C

2SC2899 MAX. Rating (Signal unit Q22)

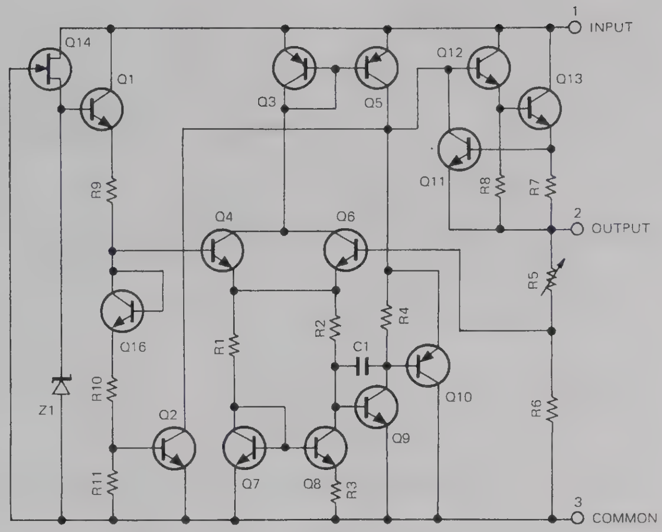
Item	Rating
Maximum permissible voltage	AC 130V rms DC 170V
Varistor voltage	180~255V
Maximum restriction voltage	340V at 10A
Maximum average pulse power	0.25W
Maximum surge current	600A

ERZ-C07DK201 MAX. Rating (Signal unit D101)

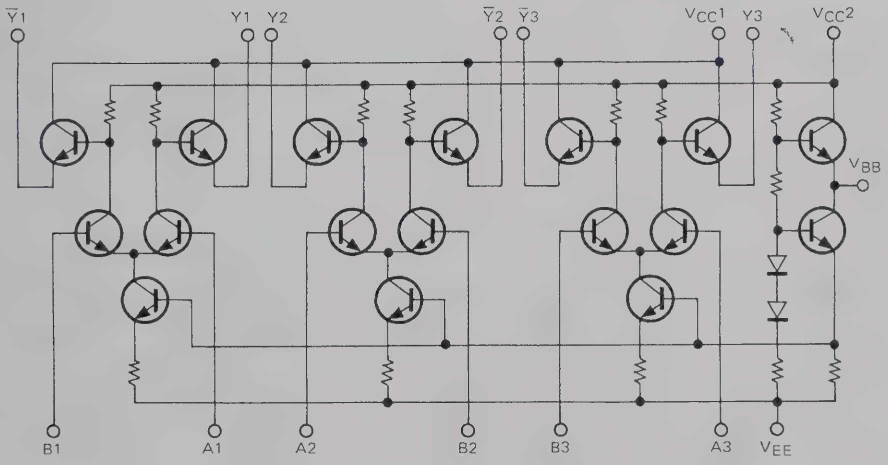
SEMICONDUCTOR DATA


INPUT (1)
OUTPUT (2)
COMMON (3)
R4 100k
R18 500
Q12
R5 3.3k
D1
R6 2.7k
R7 500
R8 100
R9 100
Q8
Q9
R13 10k
D2
Q16
Q17
Q14
R21 680
Q15
R17 200
R12 240
R11 0.3
Q10
Q13
Q6
Q5
R15 6k
R16 2k
R20 0-19k
Q11
R1 1k
R2 20k
C1 30pF
Q7
Q4
Q1
Q2
Q3
R10 6k
R3 1k
R14 6k
R19 5k

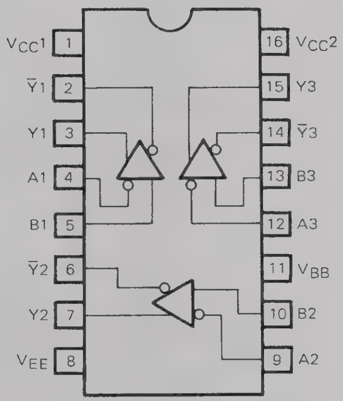
UA7818UC Equivalent circuit (Signal unit IC8)


1 INPUT
2 OUTPUT
3 COMMON
Q14
Q1
Q3
Q5
Q12
Q13
Q11
R8
R7
R9
Q4
Q6
R5
Q16
R2
R4
R1
C1
Q10
R10
Z1
Q2
Q9
R6
R11
Q7
Q8
R3

TA78L005AP Equivalent circuit (AT unit Q27)


Ȳ1
Y1
Y2
Ȳ2
Ȳ3
VCC1
Y3
VCC2
VBB
B1
A1
A2
B2
B3
A3
VEE

HD10116 Equivalent circuit (AT unit Q30)


VCC1 1
Ȳ1 2
Y1 3
A1 4
B1 5
Ȳ2 6
Y2 7
VEE 8
16 VCC2
15 Y3
14 Ȳ3
13 B3
12 A3
11 VBB
10 B2
9 A2

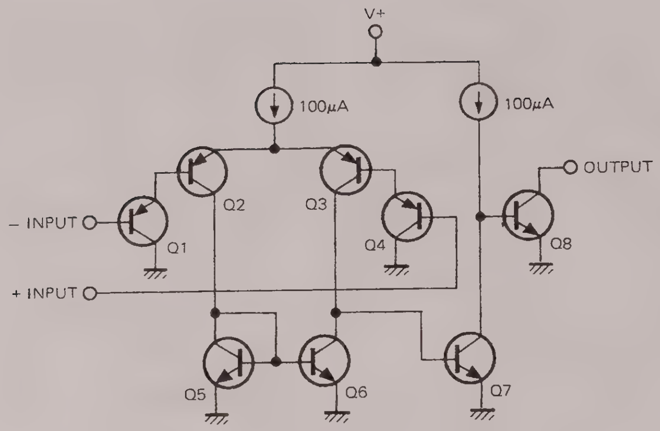
HD10116 (TOP VIEW)

Item	Symbol	Rating
Collector-Base voltage	V_{CBO}	−35V
Collector-Emitter voltage	V_{CEO}	−30V
Emitter-Base voltage	V_{EBO}	−5V
Continuous Collector current	I_C	−800mA
Continuous Emitter current	I_E	800mA
Collector dissipation	P_C	600mW
Operating temperature	Tj	150°C
Storage temperature	Tstg	−55～+150°C

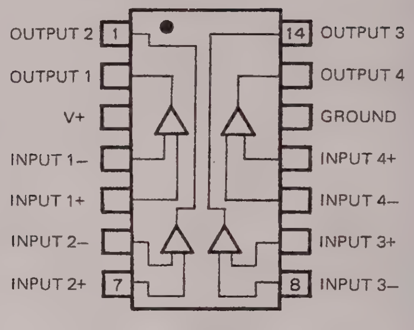
Ta=25°C

2SA950 MAX. Rating (AT unit Q14,15,20,21)

SEMICONDUCTOR DATA


V+
100μA
100μA
OUTPUT
– INPUT
+ INPUT
Q1
Q2
Q3
Q4
Q5
Q6
Q7
Q8

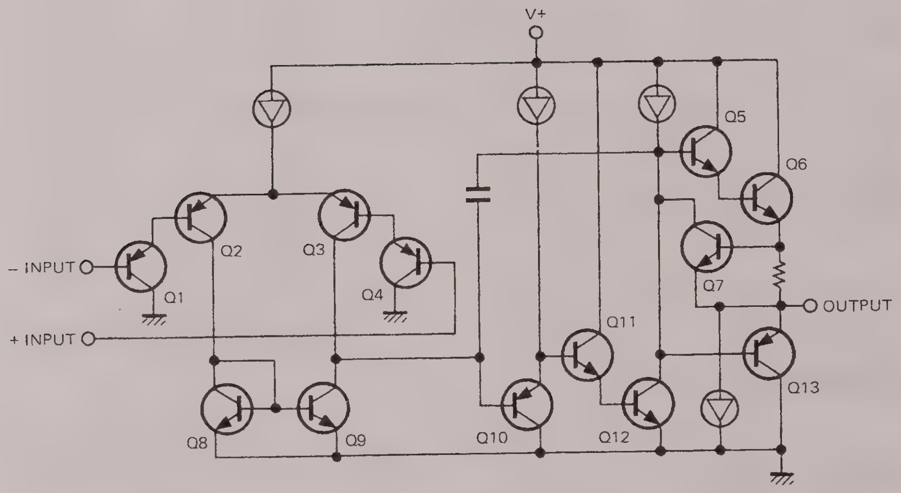
NJM2901 Equivalent circuit (AT unit Q39)


OUTPUT 2
OUTPUT 1
V+
INPUT 1–
INPUT 1+
INPUT 2–
INPUT 2+
1
7
14
8
OUTPUT 3
OUTPUT 4
GROUND
INPUT 4+
INPUT 4–
INPUT 3+
INPUT 3–

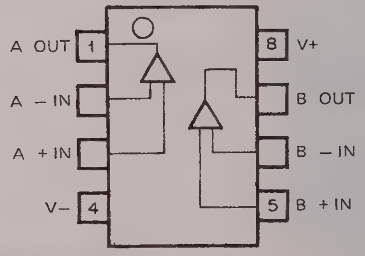
NJM2901

Item	Voltage supply	Power consumption	Differential input voltage	Input voltage	Operating temperature	Storage temperature
Symbol	Vs	P_T	V_{IDR}	V_{ICR}	Topr	Tstg
Rating	36V	570mW	36V	–0.3~+36V	–40~+85°C	–50~+125°C

NJM2901 MAX. Rating


V+
– INPUT
+ INPUT
OUTPUT
Q1
Q2
Q3
Q4
Q5
Q6
Q7
Q8
Q9
Q10
Q11
Q12
Q13

NJM2904D Equivalent circuit (AT unit Q40)

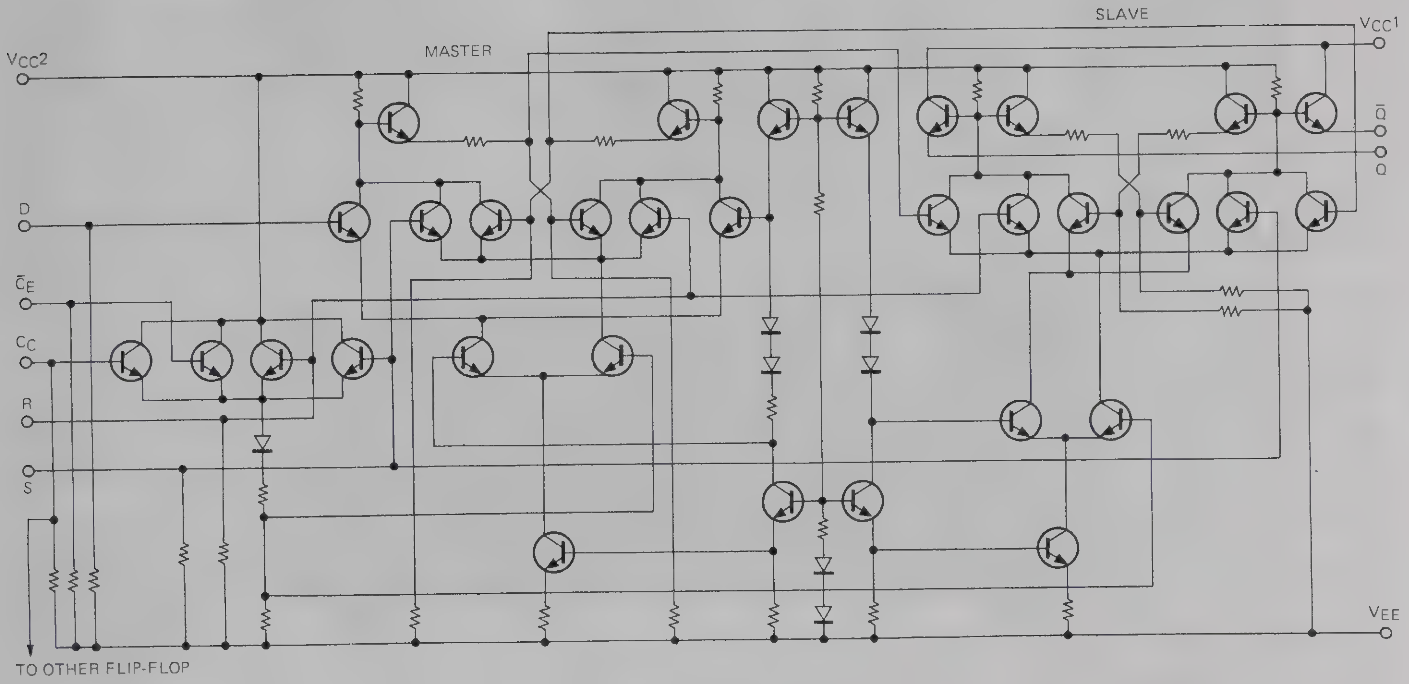

A OUT
A – IN
A + IN
V–
1
4
8
5
V+
B OUT
B – IN
B + IN

NJM2904D

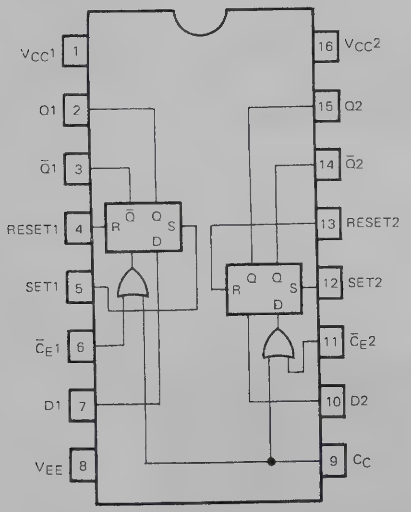
Item	Voltage supply	Power consumption	Differential input voltage	Input voltage	Operating temperature	Storage temperature
Symbol	Vs	P_T	V_{ID}	V_{ICM}	Topr	Tstg
Rating	32±16V	500mW	–0.3~+26V	–0.3~+32V	–20~+75°C	–40~+125°C

NJM2904D MAX. Rating

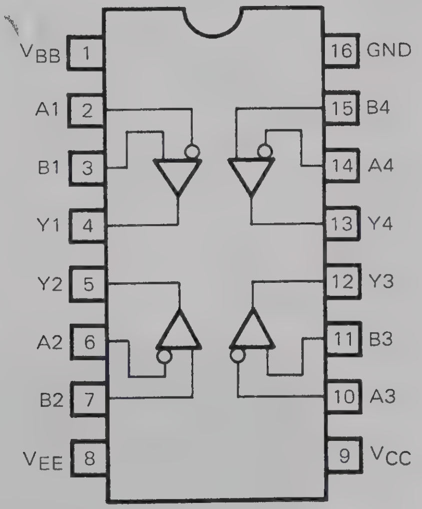
SEMICONDUCTOR DATA


MASTER
SLAVE
VCC2
VCC1
D
C̄E
CC
R
S
Q̄
Q
VEE
TO OTHER FLIP-FLOP

HD10131 Equivalent circuit 1/2 (AT unit Q29)

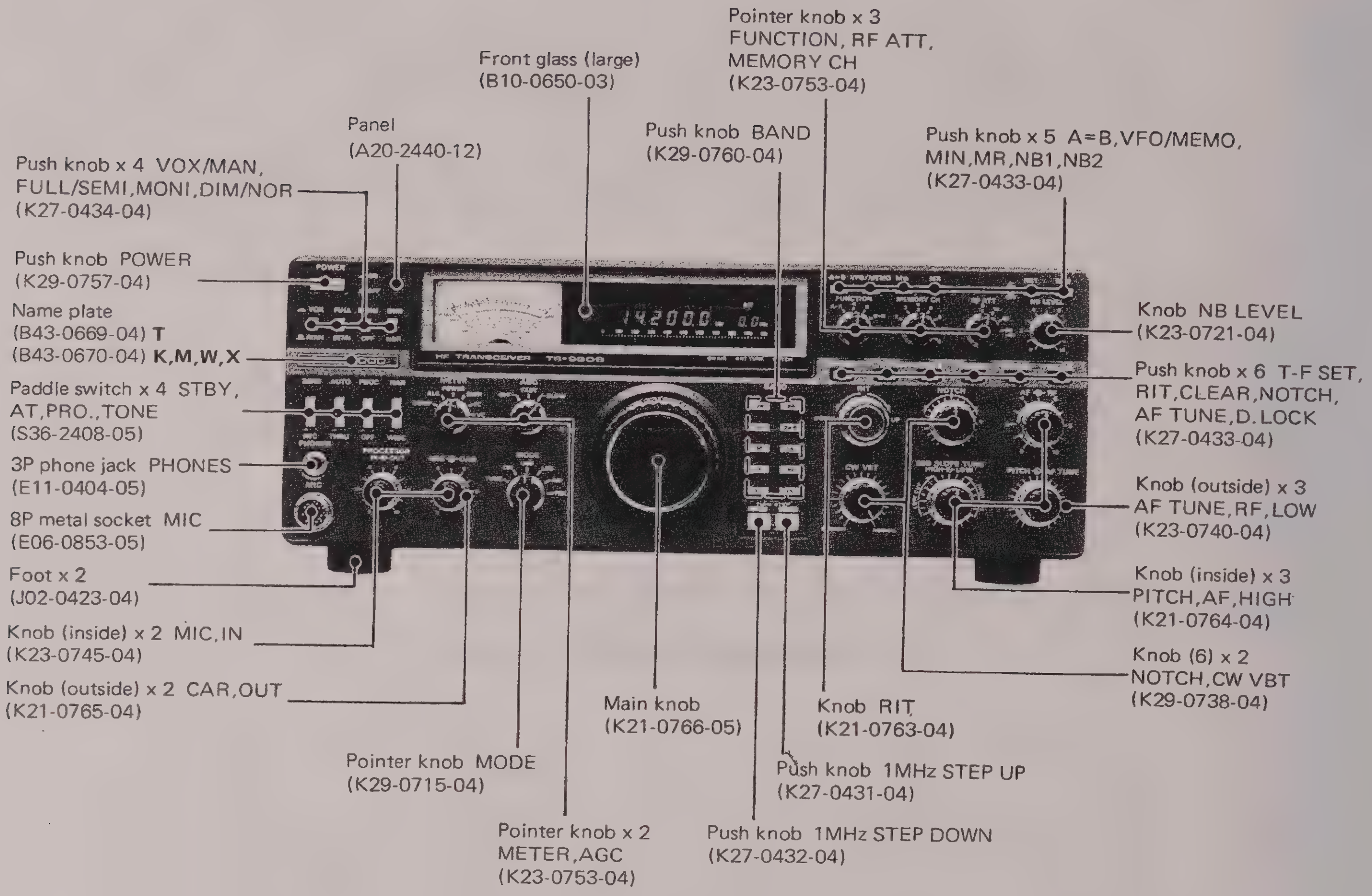

VCC1 1
Q1 2
Q̄1 3
RESET1 4
SET1 5
C̄E1 6
D1 7
VEE 8
16 VCC2
15 Q2
14 Q̄2
13 RESET2
12 SET2
11 C̄E2
10 D2
9 CC
R Q̄ Q S D
R Q Q S D

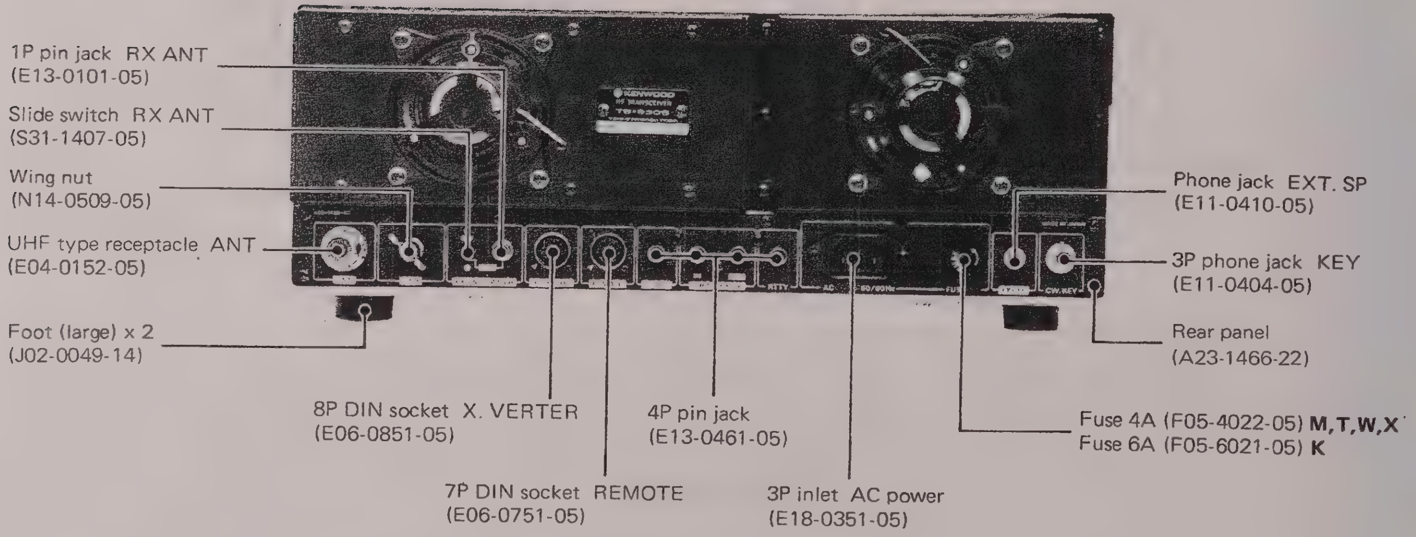
HD10131 (TOP VIEW)


VBB 1
A1 2
B1 3
Y1 4
Y2 5
A2 6
B2 7
VEE 8
16 GND
15 B4
14 A4
13 Y4
12 Y3
11 B3
10 A3
9 VCC

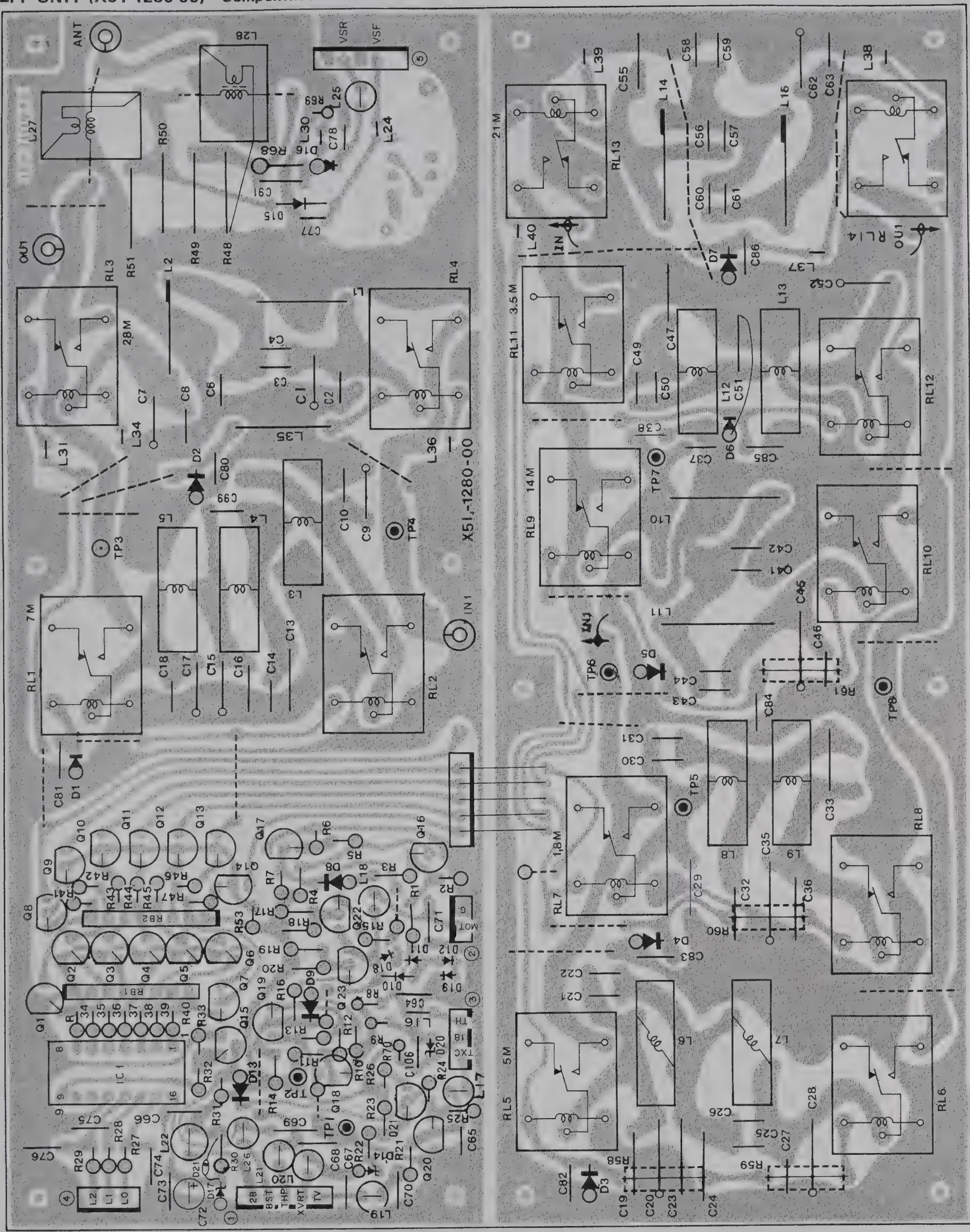
HD10125 (AT unit Q28)
(TOP VIEW)

OUTSIDE VIEWS


Pointer knob x 3
FUNCTION, RF ATT,
MEMORY CH
(K23-0753-04)
Front glass (large)
(B10-0650-03)
Panel
(A20-2440-12)
Push knob BAND
(K29-0760-04)
Push knob x 5 A=B,VFO/MEMO,
MIN,MR,NB1,NB2
(K27-0433-04)
Push knob x 4 VOX/MAN,
FULL/SEMI,MONI,DIM/NOR
(K27-0434-04)
Push knob POWER
(K29-0757-04)
Name plate
(B43-0669-04) **T**
(B43-0670-04) **K,M,W,X**
Paddle switch x 4 STBY,
AT,PRO.,TONE
(S36-2408-05)
3P phone jack PHONES
(E11-0404-05)
8P metal socket MIC
(E06-0853-05)
Foot x 2
(J02-0423-04)
Knob (inside) x 2 MIC,IN
(K23-0745-04)
Knob (outside) x 2 CAR,OUT
(K21-0765-04)
Knob NB LEVEL
(K23-0721-04)
Push knob x 6 T-F SET,
RIT,CLEAR,NOTCH,
AF TUNE,D.LOCK
(K27-0433-04)
Knob (outside) x 3
AF TUNE,RF,LOW
(K23-0740-04)
Knob (inside) x 3
PITCH,AF,HIGH
(K21-0764-04)
Knob (6) x 2
NOTCH,CW VBT
(K29-0738-04)
Main knob
(K21-0766-05)
Knob RIT
(K21-0763-04)
Pointer knob MODE
(K29-0715-04)
Push knob 1MHz STEP UP
(K27-0431-04)
Pointer knob x 2
METER,AGC
(K23-0753-04)
Push knob 1MHz STEP DOWN
(K27-0432-04)

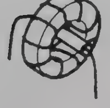

1P pin jack RX ANT
(E13-0101-05)
Slide switch RX ANT
(S31-1407-05)
Wing nut
(N14-0509-05)
UHF type receptacle ANT
(E04-0152-05)
Foot (large) x 2
(J02-0049-14)
Phone jack EXT. SP
(E11-0410-05)
3P phone jack KEY
(E11-0404-05)
Rear panel
(A23-1466-22)
8P DIN socket X. VERTER
(E06-0851-05)
4P pin jack
(E13-0461-05)
Fuse 4A (F05-4022-05) **M,T,W,X**
Fuse 6A (F05-6021-05) **K**
7P DIN socket REMOTE
(E06-0751-05)
3P inlet AC power
(E18-0351-05)

LPF UNIT (X51-1280-00) **Component side view**

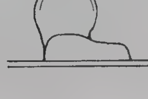

ANT
OUT
IN1
IN
OUT
INJ
VSR
VSF
X51-1280-00
28M
21M
14M
7M
3.5M
1.8M
5M
RL1
RL2
RL3
RL4
RL5
RL6
RL7
RL8
RL9
RL10
RL11
RL12
RL13
RL14
L27
L28
TP1
TP2
TP3
TP4
TP5
TP6
TP7
TP8
IC1
RB1
RB2
MOT
TXC
TH
BST
THP
XVRT
TV
L2
L1
L0

Q1–7,15–19 : 2SC1815(Y) Q8–14,20,22,23 : 2SC1959(Y) Q21 : 2SA733(P) IC1 : MB74LS42M-G
D1–7,10,12,13,18,19,21 : 1S1555 D8,9 : 1N60 D11 : XZ-090 D14 : WZ-120 D15 : 1S1007 D16 : 1S1587 D17 : XZ-055 D20 : XZ-180

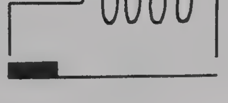
< Attachment method of L27,28 >



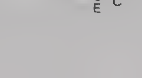
< Attachment method of C2,7,9,15,17,20,35, 45,52,62 >



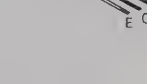
< Attachment method of L2,14,15 >



2SA733

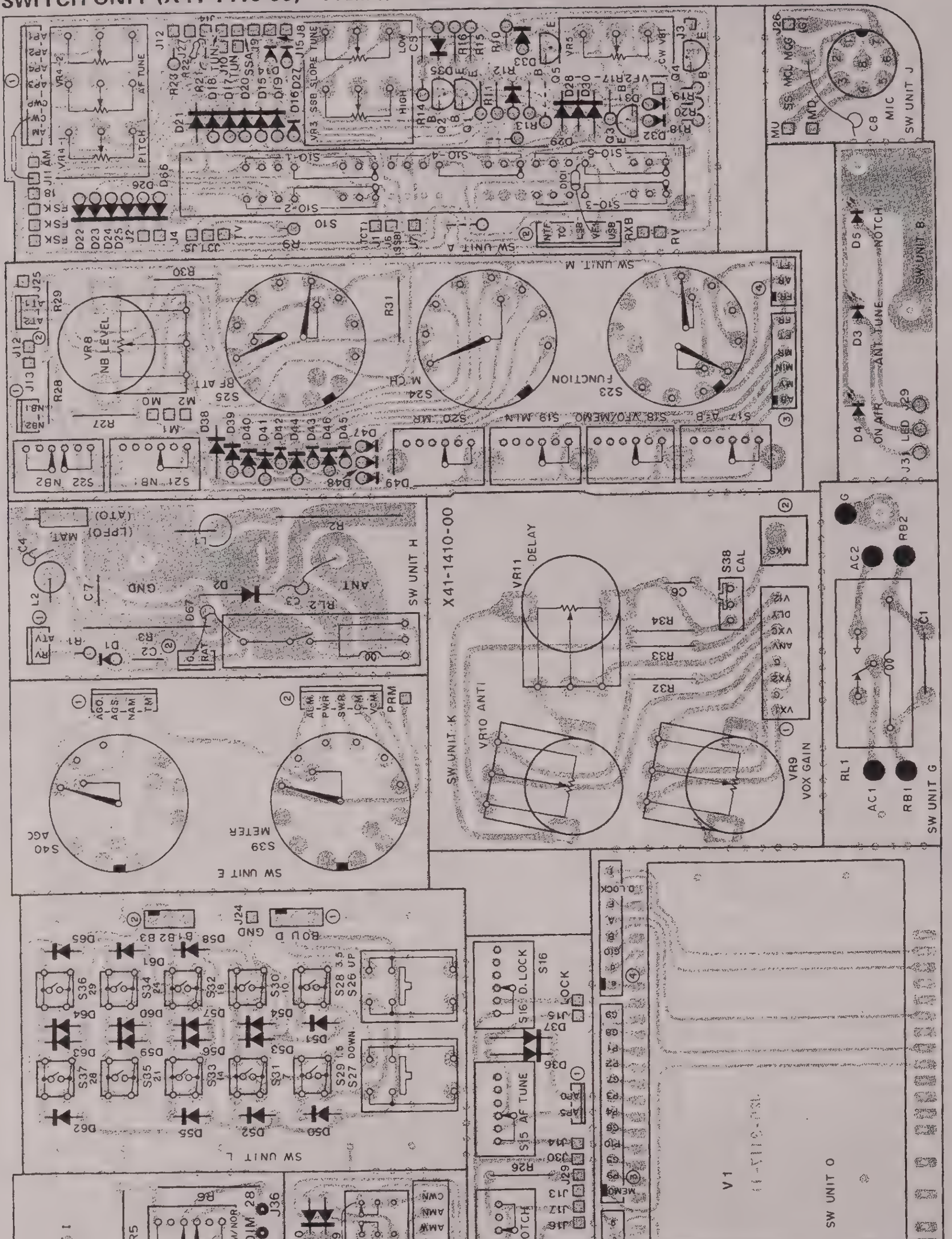


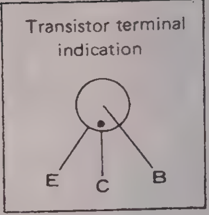
2SC1815
2SC1959



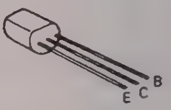
TS-930S PC BOARD VIEW

SWITCH UNIT (X41-1410-00) From S/N 208XXXX–309XXXX Component side view

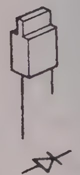

SW UNIT A
SW UNIT J
SW UNIT B
SW UNIT M
SW UNIT H
X41-1410-00
SW UNIT K
SW UNIT G
SW UNIT E
SW UNIT L
SW UNIT O
SW UNIT I
SW UNIT C
SW UNIT N
SW UNIT F
SW UNIT D
V1
FUNCTION
NB LEVEL
VOX GAIN
ANTI
DELAY
METER
AGC
RF GAIN AF GAIN
NOTCH
PROCESSOR
MIC/CAR


Transistor terminal indication

2SA1015
2SC1815



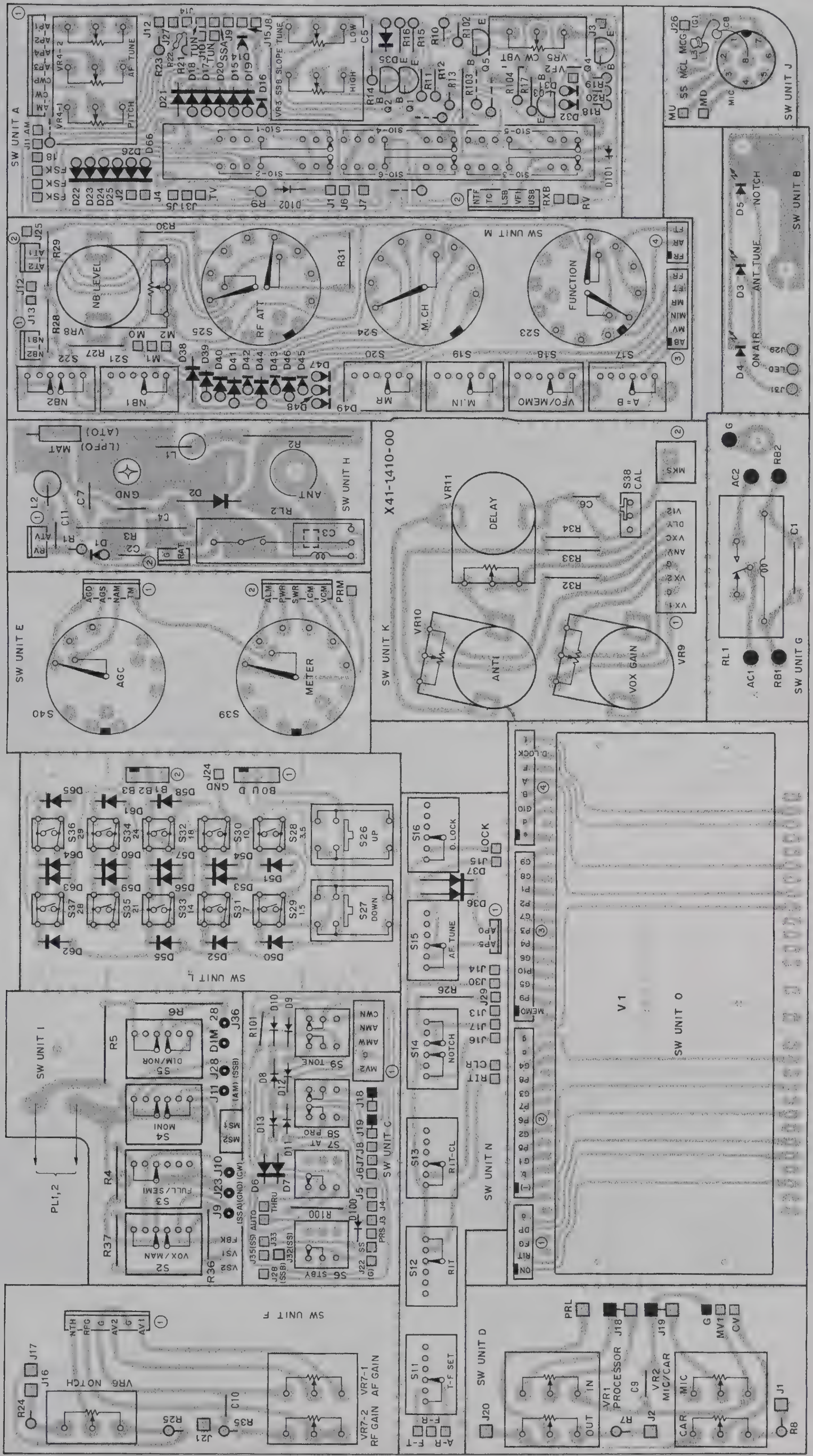
BG5532K
PR5532K



Q1–4 : 2SC1815(Y) Q5 : 2SA1015(Y)
D1,6–34,36–66,100,101 : 1S1555 D2 : GM-3A D3 : BG5532K
D4,5 : PR5532K D35 : XZ-051 D67 : ERZD03DK331 V1 : 11-BT-03Z

SWITCH UNIT (X41-1410-00)

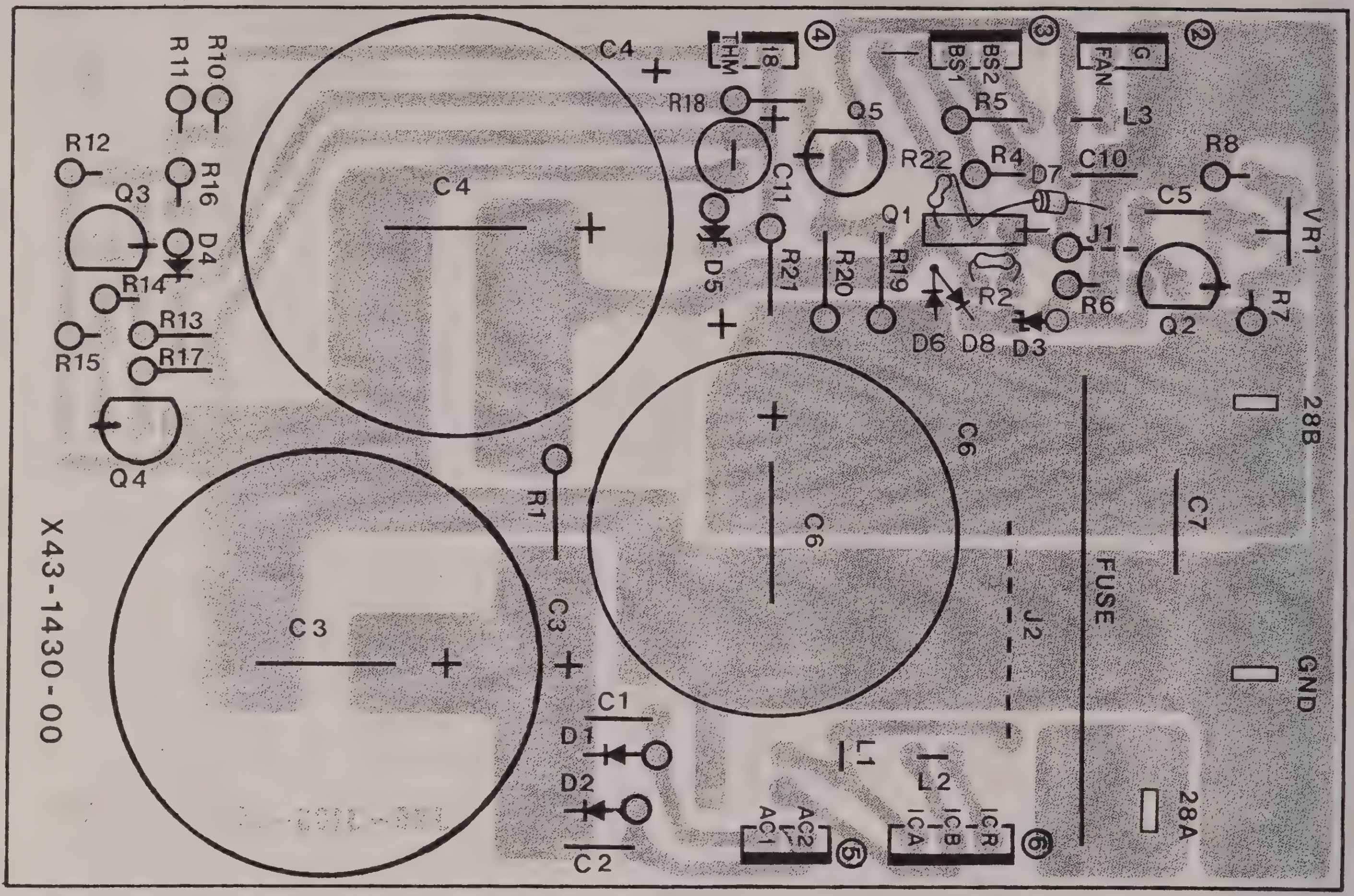
From S/N 310XXXX— Component side view


SW UNIT A
SW UNIT B
SW UNIT C
SW UNIT D
SW UNIT E
SW UNIT F
SW UNIT G
SW UNIT H
SW UNIT I
SW UNIT J
SW UNIT K
SW UNIT L
SW UNIT M
SW UNIT N
SW UNIT O
X41-1410-00
AF TUNE
PITCH
SSB SLOPE TUNE
CW VBT
NOTCH
ANT TUNE
ON AIR
NB LEVEL
RF ATT
M.CH
FUNCTION
NB2
NB1
MR
M.IN
VFO/MEMO
A=B
DELAY
ANTI
VOX GAIN
AGC
METER
S26 UP
S27 DOWN
D.LOCK
AF TUNE
NOTCH
RIT-CL
RIT
T-F SET
DIM/NOR
MONI
FULL/SEMI
VOX/MAN
TONE
PRO
AT
STBY
V1
PL1,2
VR6 NOTCH
VR7-1 AF GAIN
VR7-2 RF GAIN
VR1 PROCESSOR
VR2 MIC/CAR
MIC
CAR
IN
OUT
RL1
RL2
ANT
GND

Q1–4 : 2SC1815(Y) Q5 : 2SA1015(Y)
D1,6–26,31,32,36–66,100–102 : 1S1555 D2 : GM-3B
D3 : BG5532K D4,5 : PR5532K D35 : XZ-060
D67 : D5A-441LA V1 : 11-BT-03Z

TS-930S PC BOARD VIEWS

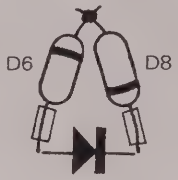
POWER SUPPLY UNIT (X43-1430-00) From S/N 208XXXX–309XXXX Component side view



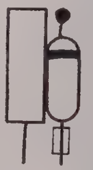
R10
R11
R12
R16
Q3
D4
R14
R13
R15
R17
Q4
C4
C3
R1
C1
D1
D2
C2
THM
18
④
R18
Q5
C11
D5
R21
R20
R19
BS2
BS1
③
R5
R22
R4
D7
Q1
D6
D8
R2
D3
FAN
G
②
L3
C10
R8
C5
J1
R6
VR1
Q2
R7
28B
C6
C7
FUSE
J2
GND
L1
L2
AC2
AC1
⑤
ICA
ICB
ICR
⑥
28A
X43-1430-00

Q1 : 2SA1021(O) Q2–4 : 2SC1815(Y) Q5 : 2SC1959(Y)
D1,2 : V03(C) D3 : XZ-122 D4,6 : 1S1555 D5 : WZ-182 D7 : BZ-320 D8 : SV-03Y

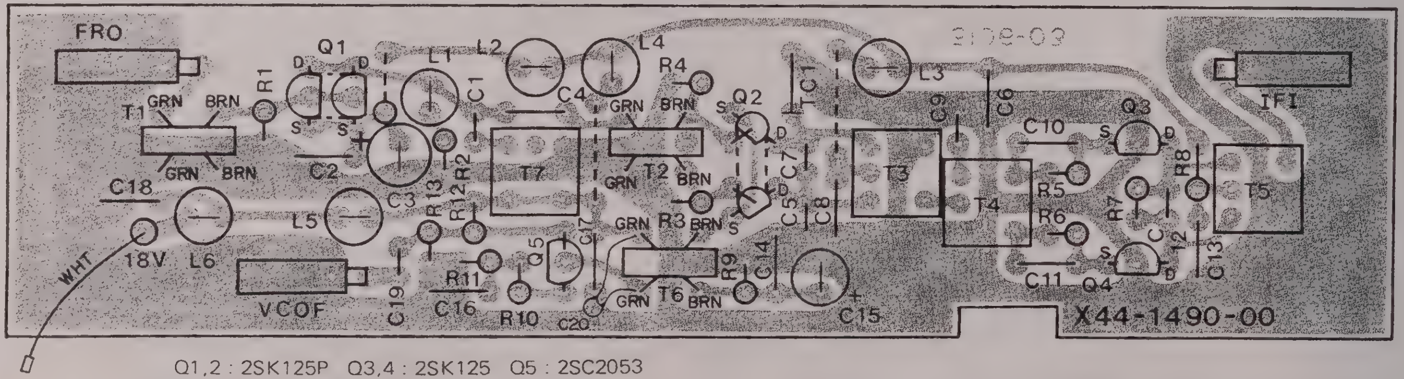
< Attachment method of D6,8 >



< Attachment method of Q1,D6,8 >



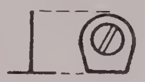
RF UNIT (X44-1490-00) From S/N 208XXXX–309XXXX Component side view



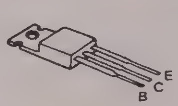
FRO
Q1
D
D
S
S
R1
T1
GRN
BRN
GRN
BRN
L1
L2
C1
L4
R4
C4
GRN
BRN
T2
GRN
BRN
Q2
S
D
TC1
L3
C9
C6
IFI
C10
Q3
S
D
C2
C3
R13
R12
R2
T7
C7
C5
C8
T3
T4
R5
R6
R7
R8
C12
T5
C13
C18
18V
L6
WHT
L5
VCOF
C19
R11
C16
R10
Q5
C17
C20
GRN
R3
BRN
T6
GRN
BRN
R9
C14
C15
C11
Q4
S
D
X44-1490-00

Q1,2 : 2SK125P Q3,4 : 2SK125 Q5 : 2SC2053

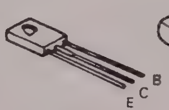
< Attachment method of TC1 >



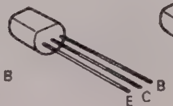
2SB861



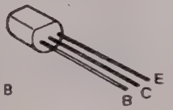
2SA1021



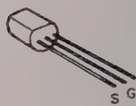
2SC1815
2SC1959
2SC2235



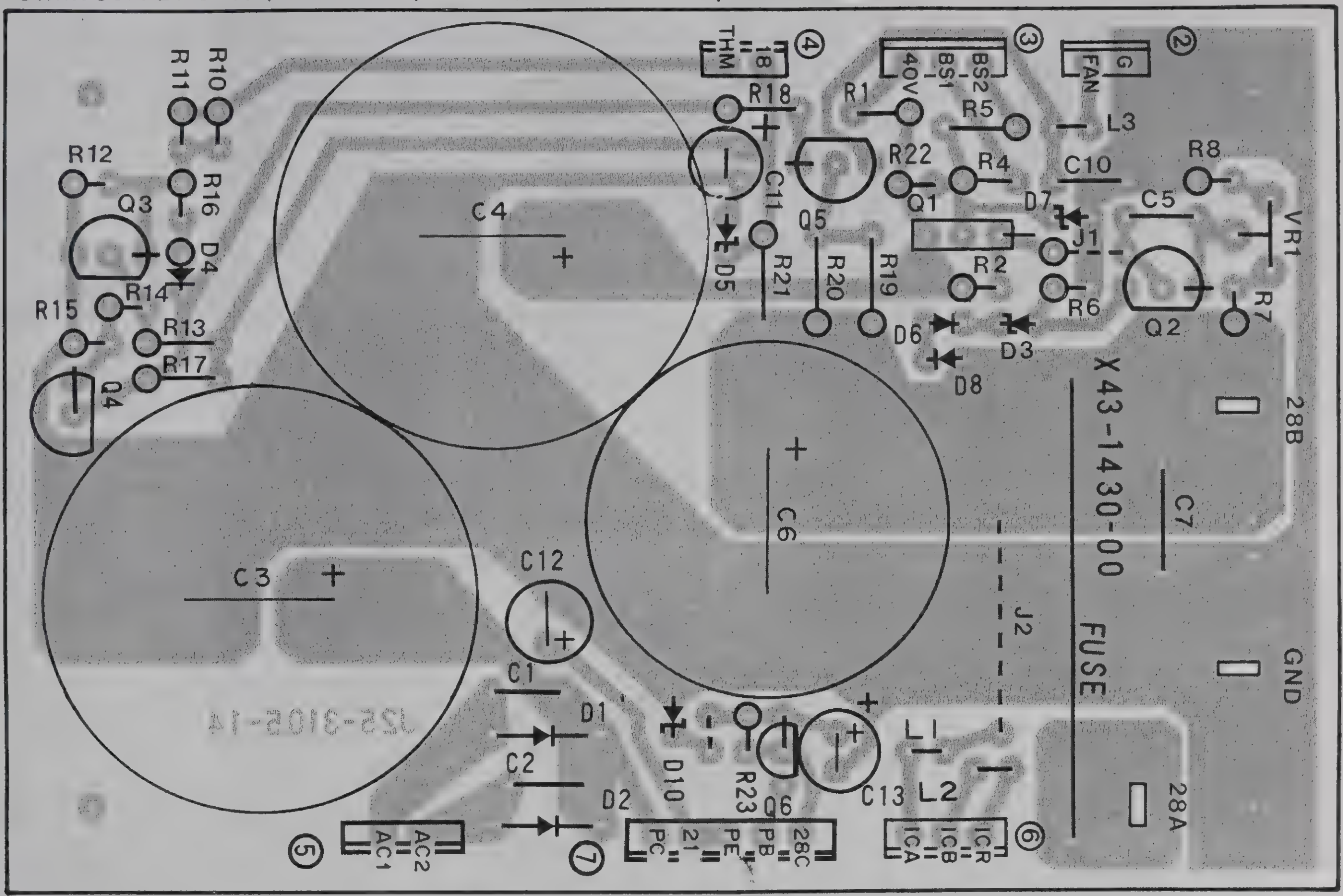
2SC2053



2SK125

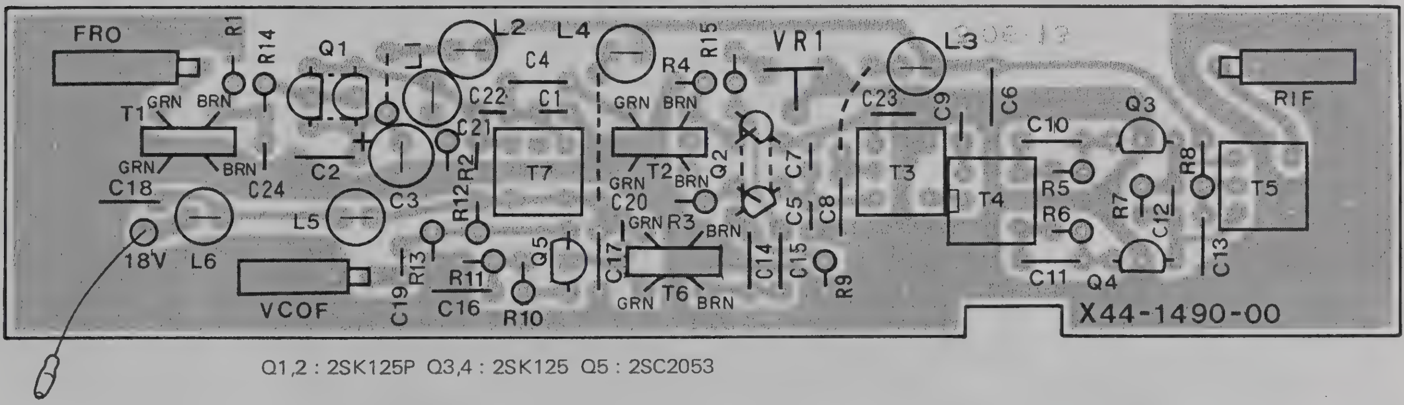


POWER SUPPLY UNIT (X43-1430-00) From S/N 310XXXX– Component side view


R10
R11
R12
R16
Q3
D4
R14
R15
R13
R17
Q4
C4
C3
C12
C1
C2
D1
D2
D10
R23
Q6
C13
L1
L2
THM
18
④
R18
C11
D5
R21
Q5
R20
R19
40V
BS1
BS2
③
R1
R5
R22
R4
Q1
D6
D8
R2
FAN
G
②
L3
C10
D7
J1
R6
D3
R8
C5
VR1
Q2
R7
X43-1430-00
28B
C7
C6
J2
FUSE
GND
28A
J25-3105-14
⑤
AC2
AC1
⑦
PC
21
PE
PB
28C
ICA
ICB
ICR
⑥

Q1 : 2SB861(C) Q2–4 : 2SC1815(Y) Q5 : 2SC1959(Y) Q6 : 2SC2235(O)
D1,2 : U05B D3 : XZ-122 D4,6 : 1S1555 D5 : WZ-182 D7 : RD33FBD-B1
D8 : SV-03Y D10 : XZ-225

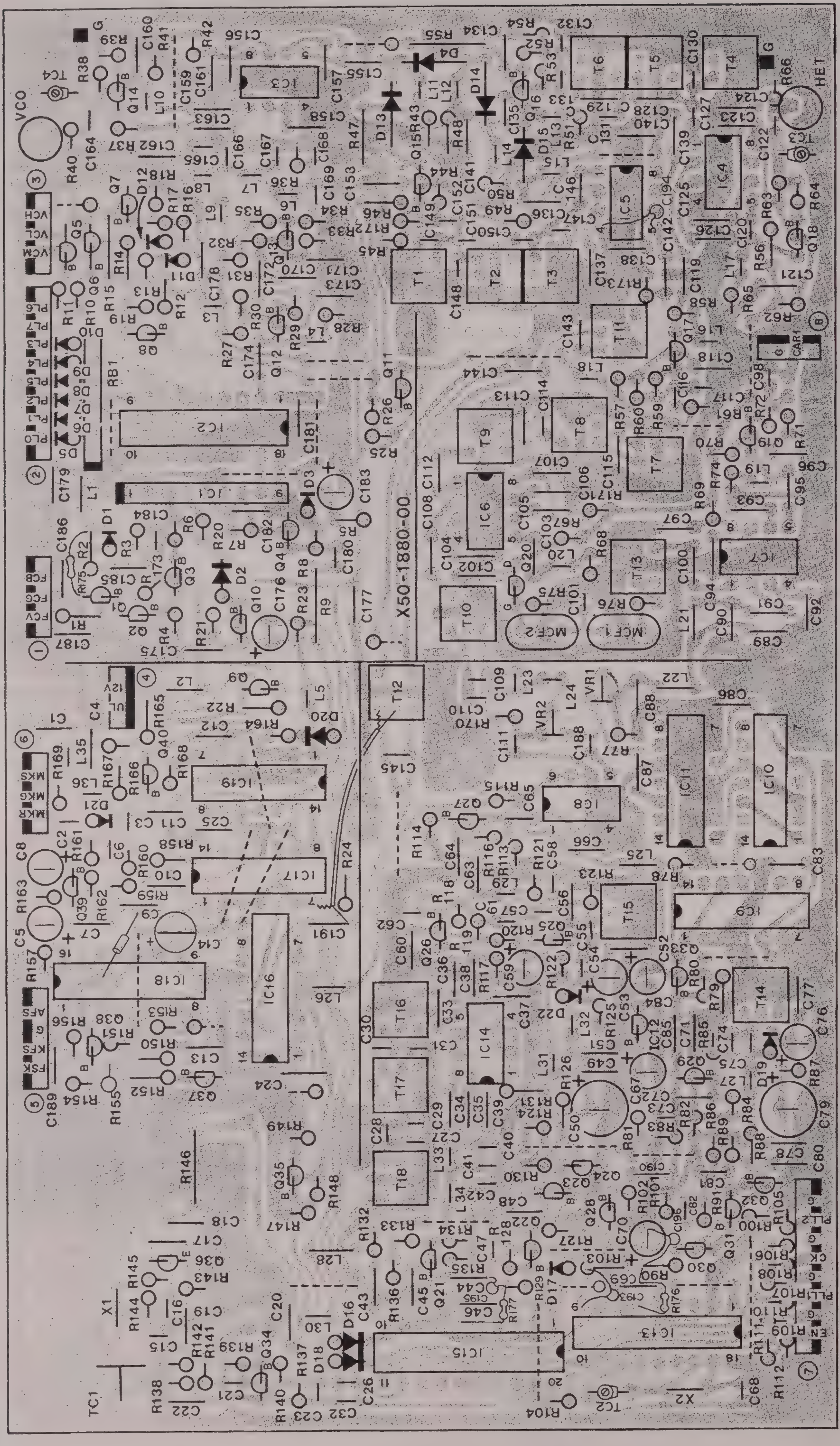
RF UNIT (X44-1490-00) From S/N 310XXXX– Component side view


FRO
R1
R14
Q1
L1
L2
L4
C4
R4
R15
VR1
L3
T1
GRN
BRN
C22
C1
C21
C2
C24
C18
R2
T7
T2
Q2
C7
C23
C9
C6
C10
Q3
RIF
T3
T4
R5
R6
R7
C12
R8
T5
C13
C11
Q4
C3
L5
L6
18V
R12
C20
R3
C5
C8
R13
R11
Q5
C17
T6
C14
C15
R9
VCOF
C19
C16
R10
X44-1490-00

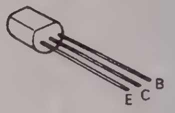
Q1,2 : 2SK125P Q3,4 : 2SK125 Q5 : 2SC2053

TS-930S PC BOARD VIEW

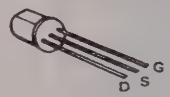
PLL UNIT (X50-1880-00) **Component side view**


X50-1880-00
VCO
HET
TC1
TC2
TC4
X1
X2
IC1
IC2
IC3
IC4
IC5
IC6
IC7
IC8
IC9
IC10
IC11
IC13
IC14
IC15
IC16
IC17
IC18
IC19
T1
T2
T3
T4
T5
T6
T7
T8
T9
T10
T11
T12
T13
T14
T15
T16
T17
T18
MCF1
MCF2
RB1
CAR1
VR1
VR2
VCH
VCL
VCM
PL6
PL7
PL3
PL4
PL5
PL1
PL0
FCB
FCG
FCV
12V
UL
MKS
MKG
MKR
AFS
KFS
FSK
CK
ST
EN
①
②
③
④
⑤
⑥
⑦
⑧

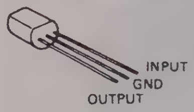
2SA1015
2SC1775
2SC1815
2SC1923



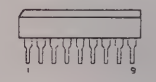
2SK19



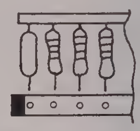
TA78L005AP


INPUT
GND
OUTPUT

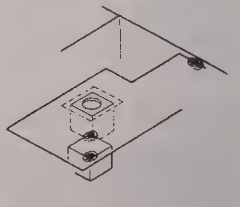
TC5081P



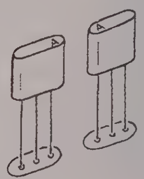
< Attachment direction of RB1 >

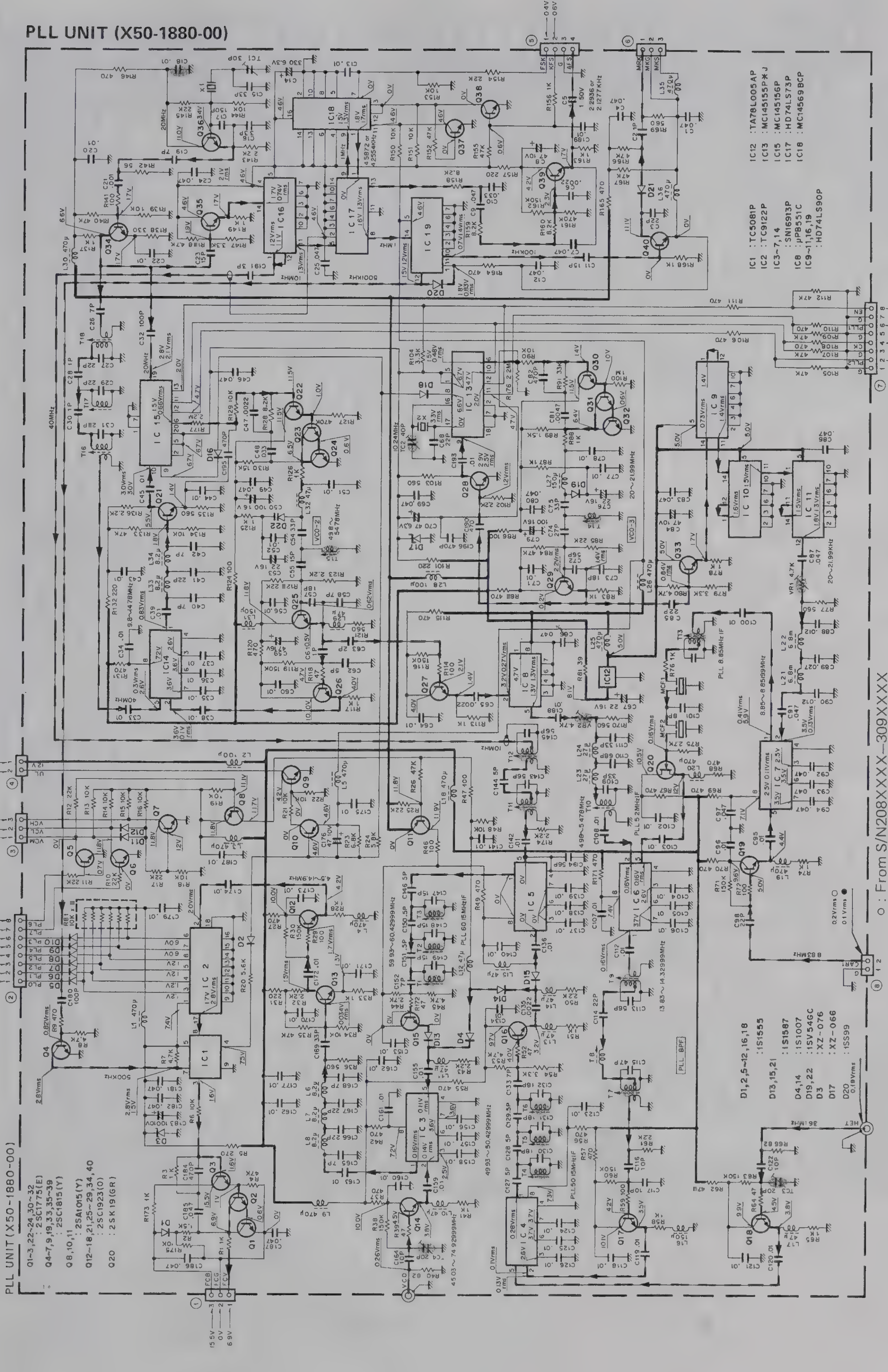


< Attachment method of shield plate >



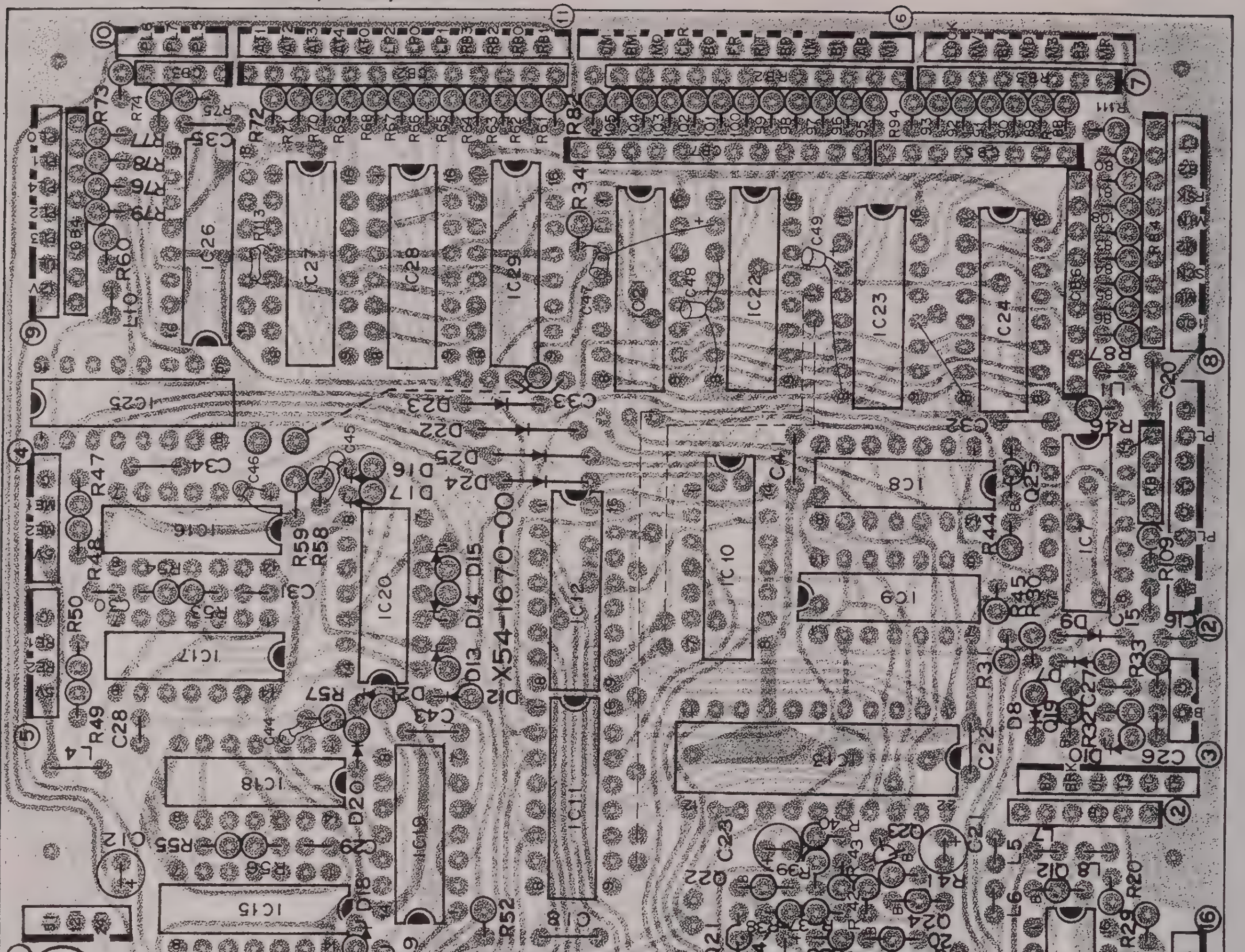
< Attachment direction of MCF >



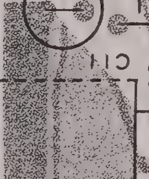

PLL UNIT (X50-1880-00)
IC1 : TC5081P
IC2 : TC9122P
IC3~7,14 : SN16913P
IC8 : μPB551C
IC9~11,16,19 : HD74LS90P
IC12 : TA78L005AP
IC13 : MC145155P✱J
IC15 : MC145156P
IC17 : HD74LS73P
IC18 : MC14569BCP
Q1~3,22~24,30~32 : 2SC1775(E)
Q4~7,9,19,33,35~39 : 2SC1815(Y)
Q8,10,11 : 2SA1015(Y)
Q12~18,21,25~29,34,40 : 2SC1923(O)
Q20 : 2SK19(GR)
D1,2,5~12,16,18 : 1S1555
D13,15,21 : 1S1587
D4,14 : 1S1007
D19,22 : 1SV54GC
D3 : XZ-076
D17 : XZ-066
D20 : 1SS99
○ : From S/N208XXXX~309XXXX
● : From S/N310XXXX~
VCO-2
VCO-3
PLL BPF
HET
CAR1
VCO

TS-930S PC BOARD VIEW

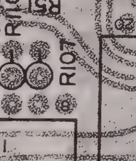
DIGITAL UNIT (X54-1670-00) **Component side view**


X54-1670-00
IC1
IC2
IC3
IC4
IC5
IC6
IC7
IC8
IC9
IC10
IC11
IC12
IC13
IC14
IC15
IC16
IC17
IC18
IC19
IC20
IC21
IC22
IC23
IC24
IC25
IC26
IC27
IC28
IC29
IC30
IC31
T1
X1
RB5
RB8
RB9
C11
C10
L1
L2
L3
L5
L6
L7
L8
L9
L10
D2
D3
D4
D5
D6
D7
D8
D9
D10
D11
D12
D13
D14
D15
D16
D17
D18
D19
D20
D21
D22
D23
D24
D25
R47
R48
R49
R50
R51
R52
R55
R56
R57
R58
R59
R60
R72
R73
R74
R82
R94
R106
R107
R109
R110
Q1
Q6
Q12
Q13
Q14
Q15
Q16
Q17
Q18
Q19
Q21
Q22
Q23
Q24
Q25
IN
OUT
VFO
MEMO
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16

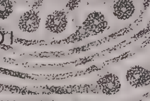
< Attachment direction of T1>



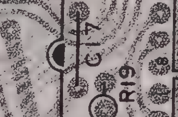
< Attachment direction of RB,CB >



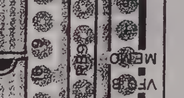
2SA1049



2SA984K 2SC1923
2SA1015 2SC1959
2SC1815 2SC2274K

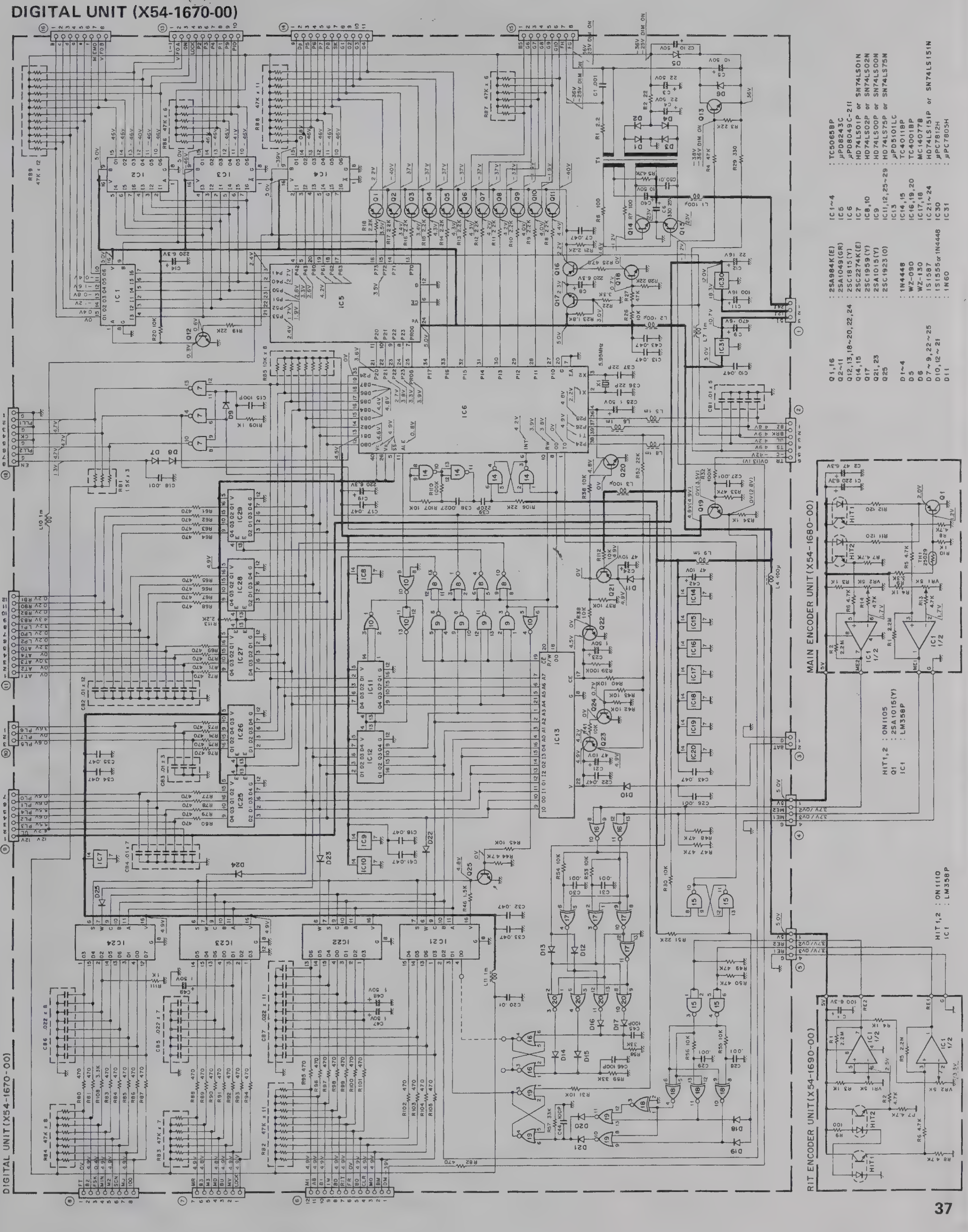


µPC14305
µPC14312



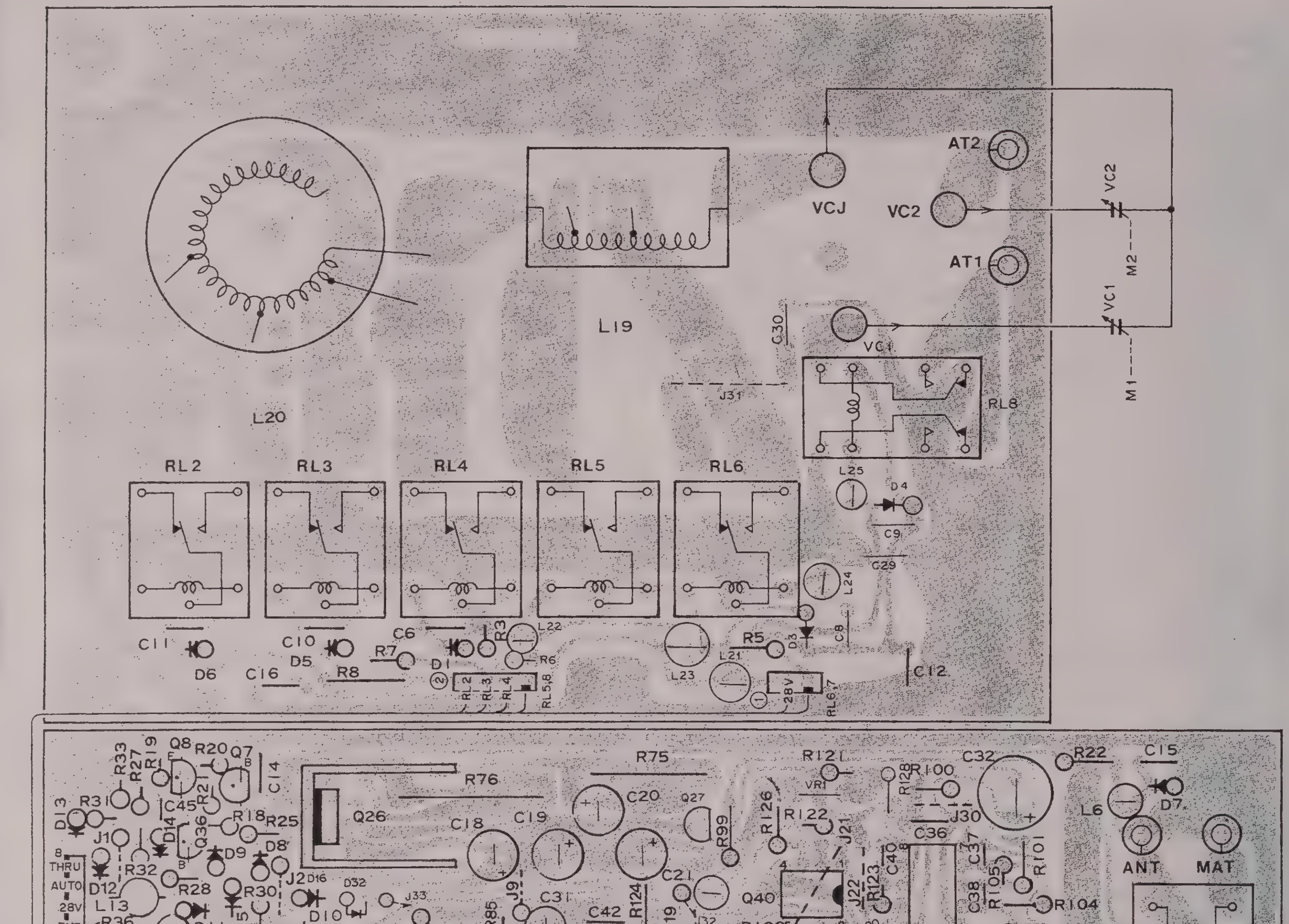
CIRCUIT DIAGRAM TS-930S

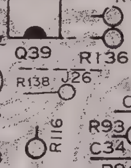
Note: Data transfer from IC21–24 only occurs when the latch signal on "S" & "W" are vertically aligned (in phase).


DIGITAL UNIT (X54-1670-00)
MAIN ENCODER UNIT (X54-1680-00)
RIT ENCODER UNIT (X54-1690-00)
Q1,16 : 2SA984K(E)
Q2~11 : 2SA1049(GR)
Q12,13,18~20,22,24 : 2SC1815(Y)
Q14,15 : 2SC2274K(E)
Q17 : 2SC1959(Y)
Q21,23 : 2SA1015(Y)
Q25 : 2SC1923(O)
D1~4 : 1N4448
D5 : WZ-090
D6 : WZ-130
D7~9,22~25 : 1S1587
D10,12~21 : 1S1555 or 1N4448
D11 : 1N60
IC1~4 : TC5065BP
IC5 : μPD8243C
IC6 : μPD8049C-211
IC7 : HD74LS01P or SN74LS01N
IC8,10 : HD74LS02P or SN74LS02N
IC9 : HD74LS00P or SN74LS00N
IC11,12,25~29 : HD74LS75P or SN74LS75N
IC13 : μPD5101LC
IC14,15 : TC4011BP
IC16,19,20 : TC4001BP
IC17,18 : MC14077B
IC21~24 : HD74LS151P or SN74LS151N
IC30 : μPC7812H
IC31 : μPC7805H
HIT1,2 : ON1105
Q1 : 2SA1015(Y)
IC1 : LM358P
HIT1,2 : ON1110
IC1 : LM358P
1
2
3
4
5
6
7

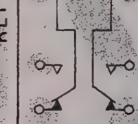
TS-930S PC BOARD VIEW

AT UNIT (X57-1010-00) Component side view


AT2
VCJ
VC2
AT1
VC1
C30
L19
L20
J31
RL8
M2
M1
RL2
RL3
RL4
RL5
RL6
L25
D4
C9
C29
L24
C11
D6
C10
D5
C16
C6
R7
R8
D1
R3
L22
R6
L23
R5
L21
D3
C8
C12
28V
RL6,7
RL5,8
NO.6
THRU
AUTO
28V
RXB
G
ISW
TUN
LED
R33
R27
R19
Q8
R20
Q7
C14
R31
D13
J1
C45
R21
Q36
D14
R18
R25
D9
D8
R32
D12
L13
R28
R30
J2
D16
D32
R36
D10
J33
L12
L16
D11
D15
R35
J3
D17
C44
J6
R14
D24
R85
J9
C31
C42
R124
D25
J19
R110
R109
Q35
J4
R29
R26
J5
R92
Q37
R37
R17
D18
D19
R38
Q13
J8
R23
Q10
R39
R34
R42
Q11
R24
R16
R15
R1
R2
C13
Q6
Q9
Q12
R40
R41
J7
R64
R66
Q24
R70
R71
R74
R63
R72
R73
Q25
Q23
R60
Q22
R59
J10
C46
R69
R51
R52
R53
Q15
Q19
R57
R56
R55
R13
R12
R11
R10
R9
AT1
AT6
AT5
AT4
AT3
AT2
C35
R62
Q20
Q21
R67
R68
R65
R46
R45
Q14
R43
Q17
R54
R61
D23
D20
J18
R58
R44
D22
Q18
IB1
C5
C4
C3
C2
C1
Q5
Q4
Q3
Q2
Q1
L5
L4
L3
L2
L1
L7
L10
IB2
R132
R131
C24
L11
C17
R129
Q16
R47
R48
D21
R50
L8
L9
R49
R76
R75
Q26
C18
C19
C20
Q27
R99
R126
R121
VR1
R122
J21
R128
R100
C32
R22
C15
L6
D7
J30
C36
C37
C40
R123
J22
R101
R105
C38
R104
ANT
MAT
C21
Q40
J32
C39
R120
R137
J20
J19
J11
J12
J13
Q34
J23
C47
J25
R106
R135
Q39
R136
R97
RL1
R103
R102
Q38
R138
J26
R96
L15
C33
J25
Q33
R139
D33
R117
R116
R93
D30
C34
J14
J15
J35
J16
C43
R98
R111
R94
TC1
AT2
Q41
R82
R84
R83
R81
R78
R79
R80
R77
Q32
Q31
VR2
J32
D31
R95
R112
R113
L17
R115
R114
AT1
Q28
C22
J27
C28
Q29
J28
J29
R86
R87
R88
Q30
C23
C27
R90
R89
D28
D29
R91
C26
D27
D26
C25
L18
X57-1010-00
RL2
RL3
RL5,8
RL6,7
RL4
28V
M2−
M2+
M1−
M1+
R130 470
M2
M1

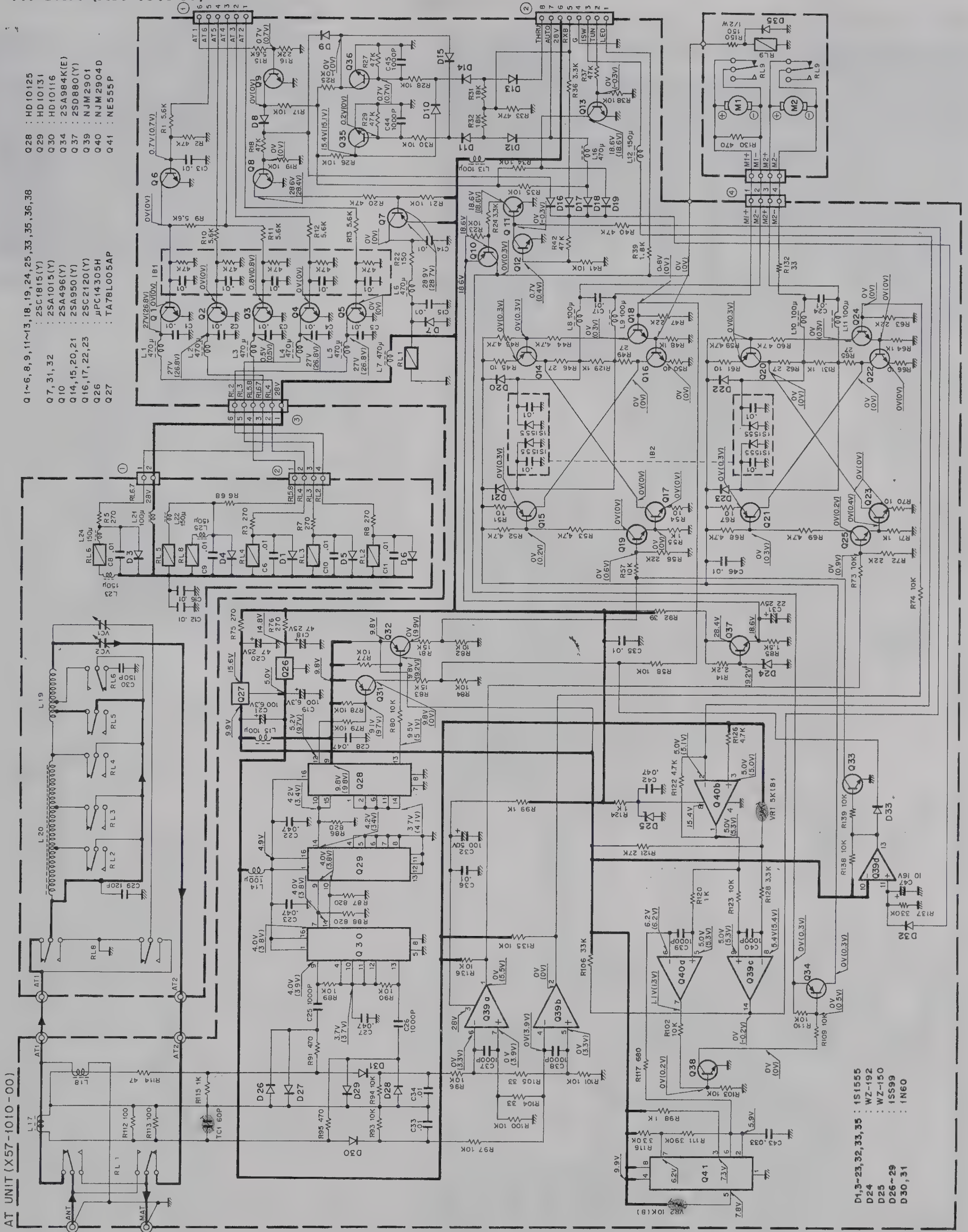


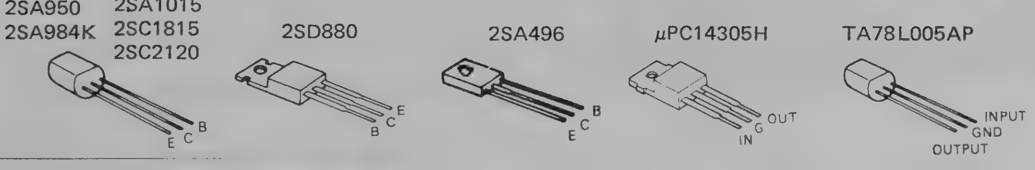
< Attachment direction of A,B >



< Attachment direction of IB1,2 >

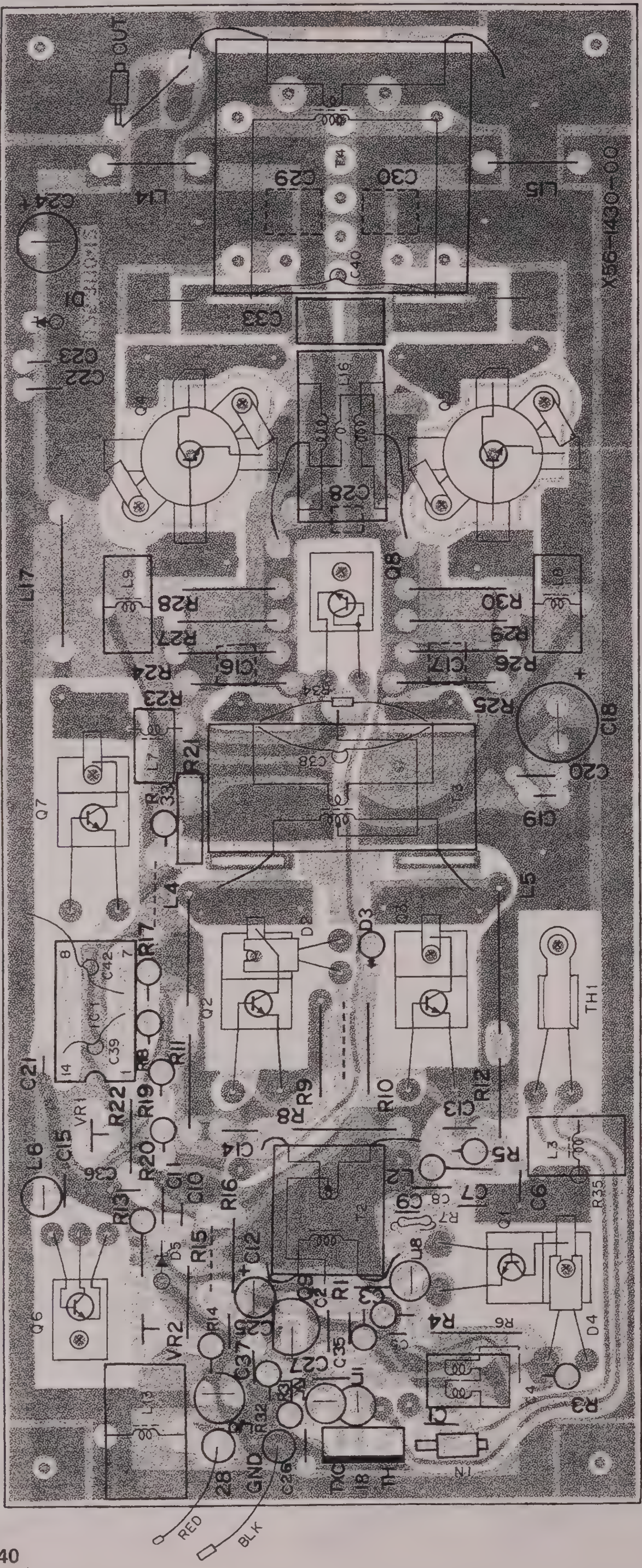
AT UNIT (X57-1010-00)


Q1~6, 8, 9, 11~13, 18, 19, 24, 25, 33, 35, 36, 38 : 2SC1815(Y)
Q7, 31, 32 : 2SA1015(Y)
Q10 : 2SA496(Y)
Q14, 15, 20, 21 : 2SA950(Y)
Q16, 17, 22, 23 : 2SC2120(Y)
Q26 : μPC14305H
Q27 : TA78L005AP
Q28 : HD10125
Q29 : HD10131
Q30 : HD10116
Q34 : 2SA984K(E)
Q37 : 2SD880(Y)
Q39 : NJM2901
Q40 : NJM2904D
Q41 : NE555P
D1, 3~23, 32, 33, 35 : 1S1555
D24 : WZ-192
D25 : WZ-150
D26~29 : 1S599
D30, 31 : 1N60
AT UNIT (X57-1010-00)
ANT
MAT
AT1
AT2
THRU AUTO 28V RXB G TSW TUN LED
M1+ M1− M2+ M2−
VR1 5K(B)
VR2 10K(B)
TC1 60P


2SA950
2SA984K
2SA1015
2SC1815
2SC2120
E C B
2SD880
B C E
2SA496
E C B
μPC14305H
IN G OUT
TA78L005AP
INPUT
GND
OUTPUT

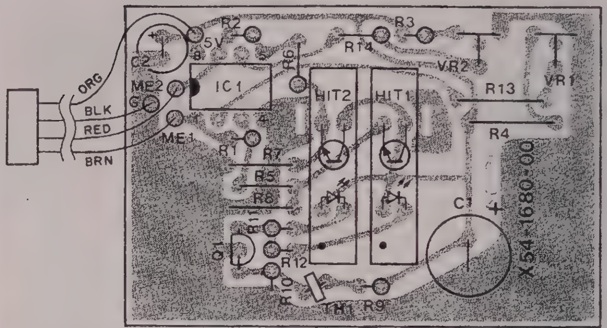
TS-930S PC BOARD VIEWS

100W FINAL UNIT (X56-1430-00) **Component side view**


P OUT
L14
L15
T4
C29
C30
C40
C24
D1
C33
C23
C22
L16
C28
L17
L9
L8
Q8
R28
R27
R30
R29
C16
C17
R24
R26
R23
R25
C18
R34
C38
T3
C20
C19
L7
R21
Q7
R33
L4
L5
D2
D3
Q2
Q3
TH1
IC1
C42
C39
R17
R18
R11
R22
R19
VR1
C21
C15
R20
R9
R8
R10
C13
R12
C14
R5
L3
R35
C36
L6
C11
C10
R16
L2
T2
C9
C8
C7
R7
C6
Q1
R13
R15
D5
C12
L8
Q6
D4
R14
VR2
R4
R6
R1
C3
C37
C27
C35
C32
L11
L13
R32
C1
R3
28
GND
C26
TXC
18
TH
NI
RED
BLK
X56-1430-00

MAIN ENCODER UNIT (X54-1680-00)

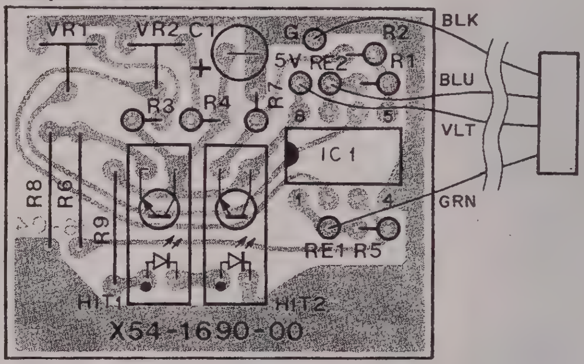
Component side view


ORG
BLK
RED
BRN
C2
ME2
G
ME1
5V
IC1
R2
R3
R14
R6
VR2
VR1
R13
R4
HIT2
HIT1
R1
R7
R5
R8
Q1
R11
R12
R10
TH1
R9
C1
X54-1680-00

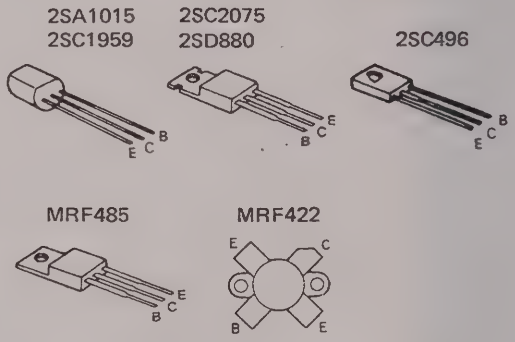
HIT1,2 : ON1105 Q1 : 2SA1015(Y) IC1 : LM358P

RIT ENCODER UNIT (X54-1690-00)

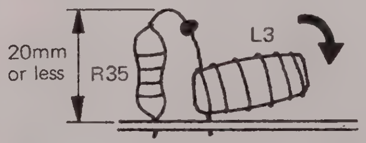
Component side view


VR1
VR2
C1
G
R2
BLK
5V
RE2
R1
BLU
R3
R4
R7
VLT
IC1
R8
R6
R9
GRN
RE1
R5
HIT1
HIT2
X54-1690-00

HIT1,2 : ON1110 IC1 : LM358P


2SA1015
2SC1959
E C B
2SC2075
2SD880
B C E
2SC496
E C B
MRF485
B C E
MRF422
E
C
B
E

< Attachment method of R35 and L3 >


20mm
or less
R35
L3

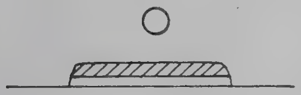
Q1 : 2SC2075 Q2,3 : MRF485 Q4,5 : MRF422
Q6,8 : 2SC496(Y) Q7 : 2SD880(Y) Q9 : 2SC1959(Y)
IC1 : MC1723CL
D1 : BZ-350 D2,4 : STV3H(O) D3 : 1S1555 D5 : BZ-192

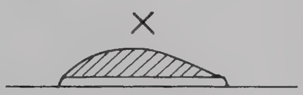
PARTS LIST

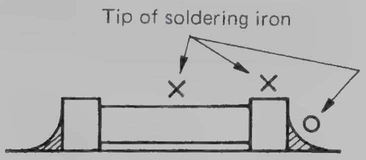
Note :

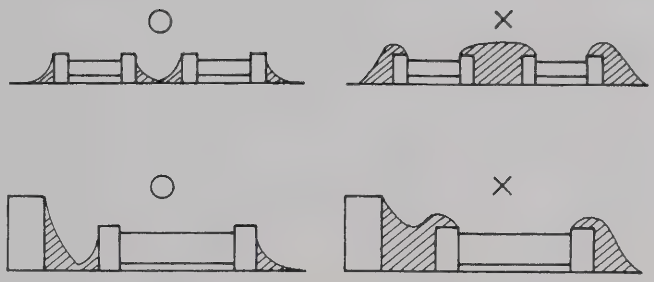
Soldering procedure for the chip capacitor

- Tools and materials
  Soldering iron
  1/8"–3/32" wide wedge tip
  Solder (Silver solder or low temperature solder)
  Soft jaw tweezers
  Hot plate or drier
- Soldering procedure
  1) Pre-heat the surface of chip capacitor up to around 150°C with the hot plate or drier.
  2) Apply solder to the tip of soldering iron.
  3) Hold and place the chip capacitor on the installation place with the tweezers.
  4) Solder one end of the chip capacitor using the tip of soldering iron.
  5) Solder the other end similarly.
- Caution
  1) Do not use too much solder. Use only enough solder to secure the component.
  2) Length of soldering time :
  In case of silver solder : Within 6 – 8 sec.
  In case of low temperature solder : Within 3 – 4 sec.
  3) Keep the temperature of tip of soldering iron below 280°C.









Note: If you damage the silver plating on the ends of the capacitors, they should be discarded as they are no longer capable of performing correctly.

Use care when soldering. Liberal use of additional flux will ease the task of soldering.

Abbreviation		Abbreviation	
Cap	Capacitor	ML	Mylar
C	Ceramic	S	Styrene
E	Electrolytic	T	Tantalum
MC	Mica		

TS-930S SEMICONDUCTOR

N : New part not previously stocked for any model.

Name		Remarks	Parts No.
Diode	1JZ61	N	V11-3179-06
	1N60		V11-0051-05
	1N4448		V11-7766-06
	1S1007		V11-4160-66
	1S1555		V11-0076-05
	1S1587		V11-0370-05
	1S2588		
	1SS99	N	V11-1277-86
	BA379		V11-1263-06
	GM-3B		
	ND487R1-3R	N	V11-1266-16
	S15VB10	N	V11-1366-06
	V03(C)		V11-0290-05
	V06E		V11-0285-05
Varistor	MV-13		V21-0004-05
	STV-3H(O)	N	V21-0016-05

Name		Remarks	Parts No.
	SV-03Y		V21-0007-05
Vari-Cap	1SV54GC		V11-4173-46
	1SV54GE		V11-4173-56
	FC65M	N	V11-7776-86
Zener diode	BZ-192		V11-0311-05
	BZ-350		V11-4166-86
	CZ-078		
	RD33FBD-B1		
	WZ-040		V11-4161-56
	WZ-061		V11-0243-05
	WZ-071		V11-4160-86
	WZ-090		V11-0240-05
	WZ-120		V11-0249-05
	WZ-130		V11-0297-05
	WZ-150		V11-0307-05

PARTS LIST

Name		Re marks	Parts No.
	WZ-182		V11-4100-10
	WZ-192		V11-0308-05
	XZ-033		V11-4176-96
	XZ-051		V11-4103-60
	XZ-055		V11-4105-51
	XZ-066		V11-4106-70
	XZ-076		V11-4126-36
	XZ-090		V11-4167-06
	XZ-122		
	XZ-200		V11-4101-70
LED	BG5532K (Green)	N	V11-7261-16
	LT8001P	N	V11-4360-76
	PR5532K (Blue)		V11-7272-36
Surge absorber	ERZC07DK201	N	V11-1163-26
	ERZD03DK331		V11-1163-16
Thermistor	25D29		V11-3360-16
	SDT500		
	SDT1000		
	5T-35		V11-2262-06
	5T-41		V11-2263-06
Photo interruptor	ON1110	N	V11-1173-86
	ON1105		V11-1173-76
Display tube	11-BT-03Z	N	V40-7760-66
TR	2SA473(Y)		V01-0473-06
	2SA496(Y)		V01-0113-05
	2SA733(P)		V01-0733-16
	2SA950(Y)	N	V01-0950-16
	2SA984K(E)	N	V01-0984-10
	2SA1015(Y)		V01-1015-06
	2SA1021(O)	N	V01-1021-16
	2SA1049(GR)	N	V01-1049-16
	2SB861(C)		
	2SC460(B)		V03-0079-05
	2SC496(Y)		V03-0336-05
	2SC1775(E)		V03-1775-06
	2SC1815(Y)		V03-1815-06
	2SC1907		V03-1907-06
	2SC1923(O)		V03-1923-06
	2SC1959(Y)		V03-1959-06
	2SC1973(T)		V03-1973-16
	2SC2053		V03-2053-06
	2SC2075		V03-2075-06
	2SC2086		V03-2086-06
	2SC2120(Y)		V03-2120-06
	2SC2274K(E)	N	V03-2274-26
	2SC2458(Y)		V03-2458-06
	2SC2899	N	V03-2899-06
	2SD880(Y)		V04-0880-16
	2N5885		V08-1012-06
	MRF422	N	V08-1008-46
	MRF485	N	V08-1008-56
FET	2SK19(GR)		V09-0012-05
	2SK30A(GR)		V09-0060-05
	2SK30A(O)		V09-0056-05
	2SK30A(Y)		V09-0058-05

Name		Re marks	Parts No.
	2SK125		V09-1004-26
	2SK125P	N	V09-1004-36
	2SK192A*J(GR)		
	3SK73(GR)		V09-1002-46
IC	HA1368	N	V30-1129-16
	HD10116	N	V30-1243-06
	HD10125	N	V30-1243-16
	HD10131	N	V30-1243-26
	HD74LS00P		V30-1046-06
	HD74LS01P		V30-1009-36
	HD74LS02P		V30-1007-36
	HD74LS73P		V30-1076-16
	HD74LS75P		V30-1008-96
	HD74LS90P		V30-1083-06
	HD74LS151P		V30-1008-26
	LM358P		V30-1024-56
	MB74LS42		V30-1241-46
	MB3614	N	V30-1242-16
	MC1723CL		V30-0199-05
	MC14077B	N	V30-1211-36
	MC145155P*J	N	
	MC145156P	N	V30-1203-36
	MC14569BCP		V30-1100-06
	MD74LS90P		
	NE555P	N	V30-0686-10
	NJM2901	N	V30-1020-56
	NJM2903D	N	V30-1020-96
	NJM2904D	N	V30-1021-06
	SN74LS00N		V30-1005-66
	SN74LS01N		V30-1041-16
	SN74LS02N		V30-1041-06
	SN74LS73N		V30-1117-06
	SN74LS75N		V30-1005-16
	SN74LS90N		V30-1005-26
	SN74LS145N	N	V30-1152-26
	SN74LS151N		V30-1240-16
	SN16913P		V30-1048-06
	TA78L005AP	N	V30-1189-36
	TA7302P		V30-1134-06
	TC4001BP		V30-1066-06
	TC4011BP		V30-1030-66
	TC4049BP		V30-1009-26
	TC4073BP	N	V30-1167-16
	TC5065BP		V30-1056-16
	TC5081P		V30-1132-06
	TC9122P		V30-1036-16
	UA7818UC	N	V30-1022-46
	μPB551C	N	V30-0170-16
	μPC14305		V30-1029-26
	μPC14305H		V30-1029-36
	μPC14312		V30-1029-56
	μPD5101LC		V30-1177-36
	μPD8049C-211	N	V30-1176-46
	μPD8243C	N	V30-1177-16

PARTS LIST

○ : From S/N208XXXX–309XXXX
● : From S/N310XXXX–

TS-930S GENERAL

Parts No.	Re marks	Description	Ref. No.
A01-0922-21	N	Case (upper)	
A01-0927-21	N	Case (lower) ○	
A01-0927-31	N	Case (lower) ●	
A20-2440-12	N	Panel	
A23-1466-22	N	Rear panel	
B03-0525-04	N	Switch mask x 2 RIT	
B03-0526-04	N	Switch mask POWER	
B05-0722-04	N	SP grill cloth	
B06-0504-04	N	Front glass grill cloth	
B07-0638-04	N	Band escutcheon	
B09-0011-04		Rubber cap	
B10-0650-13	N	Front glass (large)	
B10-0651-04	N	Front glass (small)	
B30-0826-05	N	Pilot lamp x 2 28V	PL1,2
B31-0635-05	N	Meter	
B40-2605-04	N	Name plate TS-930S **T**	
B40-2606-04	N	Name plate TS-930S **K,M,W,X**	
B41-0629-04	N	Caution plate	
B42-1727-04	N	Adj. seal	
B42-1728-04	N	Adj. seal VOX CONTROL	
B42-1729-04	N	Name plate	
B42-1777-04		Adj. seal ○	
B42-1794-04	N	Adj. seal ●	
B43-0669-04		Name plate TRIO **T**	
B43-0670-04		Name plate KENWOOD **K,M,W,X**	
B43-0676-04	N	Name plate	
B46-0407-00		Warranty card **K**	
B50-3959-20	N	Instrúction manual **K,M,W,X**	
B50-3961-10	N	Instruction manual **T**	
B58-0644-11	N	Instruction sheet	
CE04W2C3R3		E 3.3 160V	C14
CK45E2H103P		C 0.01 500V x 4	C4–7
CK45F1H103Z		C 0.01 x 4	C10–13
C90-0857-05	N	E 22000 50V x 2	C8,9
C91-0079-05		C 0.01 2kV	C1
C91-0496-05		C 470pF AC 150V x 2	C2,3
E06-0751-05		7P DIN socket REMOTE	
E06-0851-05		8P DIN socket X. VERTER	
E07-0751-05		7P DIN plug Accessory	
E07-0852-05		8P metal socket Accessory **K,T,W**	
E11-0404-05		3P phone jack x 2 KEY,PHONE	
E11-0410-05		Phone jack EXT. SP	
E12-0001-15		Phone plug EXT. SP Accessory	
E13-0101-05		1P pin jack RX ANT	
E13-0461-05		4P pin jack	
E18-0351-05		3P inlet AC Power	
E20-0315-05		Terminal plate	
E23-0015-04		Lug plate x 2 GND	
E29-0407-05		Bridge connector	
E30-1643-15		AC cord ass'y **K,M**	
E30-1644-15		AC cord ass'y **T**	
E30-1645-05		AC cord ass'y **W**	
E30-1647-05		AC cord ass'y **X**	
E31-2102-05		Connector with lead	
F01-0776-23	N	Heat sink Power supply	
F05-4022-05		Fuse 4A x 2 **M,T,W,X**	F1
F05-6021-05		Fuse 6A **M**	F1
F05-6021-05		Fuse 6A x 2 **K**	F1
F07-0841-14	N	Slide cover	
F07-0842-13	N	Heat sink cover	
F09-0405-24		Fan	
F20-0525-05		Insulating sheet ●	
F20-0527-05	N	Insulating sheet x 2 TR	
F29-0014-05		Shoulder washer ●	
F29-0401-04		Capacitor mounting hardware x 2	
F29-0406-03		Fan motor mounting hardware	
F29-0421-04	N	Protective sheet x 5	
G01-0817-04	N	Coil spring x 4	
G09-0405-05		Knob fixed spring	
G09-0410-05		Knob fixed spring x 3	
G13-0662-04	N	Cushion Speaker	
G53-0510-04		Packing x 2 Case	
G53-0511-04		Packing x 2	
H01-4409-14	N	Packing carton (inside) **K,M,W,X**	
H01-4410-14	N	Packing carton (inside) **T**	
H10-1276-04		Cushion **M,X**	
H10-2558-02	N	Packing fixture (F)	
H10-2559-02	N	Packing fixture (R)	
H12-0491-04	N	Cushion **K,T,W,X**	
H20-1403-03		Protective cover	
H25-0105-04		Protective bag 150 x 350	
H25-0120-04		Protective bag	
J02-0049-14		Foot (large) x 2 Rear	
J02-0423-04		Foot x 2 Front	
J02-0424-04		Foot x 2	
J02-0426-05	N	Foot (small) x 4	
J13-0033-15		Fuse holder	
J19-1354-05		Battery case	
J61-0019-05		Vinyle tie x 20	
J61-0401-05		Nylon band x 30	
K01-0409-05	N	Handle	
K21-0763-04	N	Knob RIT	
K21-0764-04	N	Knob x 3 PITCH,AF,HIGH	
K21-0765-04	N	Knob x 2 CAR,OUT	
K21-0766-05	N	Main knob	
K23-0721-04		Knob NB LEVEL	
K23-0740-04		Knob x 3 AF TUNE,RF,LOW	
K23-0745-04		Knob x 5 MIC,VOX GAIN,ANTI, DELAY,IN	
K23-0753-04	N	Pointer knob x 5 METER,RF ATT, AGC,FUNCTION,MEMORY CH	
K27-0431-04	N	Push knob 1MHz STEP UP	
K27-0432-04	N	Push knob 1MHz STEP DOWN	
K27-0433-04	N	Push knob x 12 RIT,CLEAR,MR, TF-SET,NOTCH,AF TUNE,MIN, D. LOCK,A=B,VFO/MEMO,NB1,NB2	
K27-0434-04	N	Push knob x 4 VOX/MAN,MONI, FULL/SEMI, DIM/NOR	
K29-0715-04		Pointer knob MODE	
K29-0738-04		Knob (6) x 2 NOTCH,CW VBT	
K29-0757-04		Push knob POWER	
K29-0760-04	N	Push knob BAND	
K29-0761-04	N	Knob ring	
L01-8156-25	N	Power transformer	T1
N09-0256-05		Gnd. screw x 4	
N09-0642-04	N	Hex. head screw x 4	
N10-2030-46		Nut x 7	

PARTS LIST

Parts No.	Re-marks	Description	Ref. No.
N14-0115-05		Flange nut	
N14-0509-05		Wing nut	
N14-0512-05		Speed nut x 5	
N15-1030-41		Flat washer x 6	
N15-1040-41		Flat washer x 5	
N30-2004-41		Round screw x 6	
N30-2604-41		Round screw x 5	
N30-2605-46		Round screw x 8	
N30-2606-45		Round screw x 4	
N30-2606-46		Round screw x 3	
N30-3004-46		Round screw x 15	
N30-3006-46		Round screw x 11	
N30-3014-41		Round screw x 4	
N30-4016-46		Round screw	
N32-2006-41		Flat screw x 2	
N32-3006-41		Flat screw x 15	
N33-3006-45		Round flat screw x 2	
N35-3006-41		Bind screw x 7	
N35-3006-45		Bind screw x 5	
N35-3008-45		Bind screw x 6	
N35-4006-46		Bind screw x 2 Handle	
N35-4008-41		Bind screw x 16	
N87-2608-41		Self tapping screw x 6	
N87-2608-46		Self tapping screw x 6	
N87-3006-41		Self tapping screw x 81	
N87-3008-41		Self tapping screw x 4	
N87-3012-46		Self tapping screw x 9	
N87-3014-46		Self tapping screw x 6	
N87-4010-41		Self tapping screw x 4	
N88-2606-46		Flat tapping screw x 2	
N89-3006-45		Bind tapping screw x 15	
RC05GF2H101J		Solid 100Ω 1/2W x 2	R11,12
RC05GF2H221J		Solid 220Ω 1/2W	R13
RD05GF2H472J		Solid 4.7kΩ 1/2W	R15
RS14AB3D181J		MF 180Ω 2W x 3	R5–7
RS14AB3D220J		MF 22Ω 2W ●	R7
RS14AB3D270J		MF 27Ω 2W x 4	R1–4
RS14AB3D330J		MF 33Ω 2W	R10
RS14AB3D820J		MF 82Ω 2W x 2	R8,9
RS14AB3D822J		MF 8.2kΩ 2W	R16
R92-0619-05		Cement 0.05Ω 5W	R14
S29-2406-05	N	Voltage selector	
S31-1407-05	N	Slide switch	
S40-2437-05	N	Push switch	S38
S50-1406-05		Tact switch x 2 **M,X**	
S51-1416-05		Relay	RL1
S90-0401-05	N	Remote switch shaft MODE	
T07-0221-05	N	Speaker	
T42-0302-05		Fan motor	
T91-0316-15		Microphone **M,X**	
X41-1410-00	N	Switch unit	
X43-1430-00	N	Power supply unit	
X44-1490-00	N	RF unit	
X50-1880-00	N	PLL unit	
X51-1280-00	N	LPF unit	
X54-1670-00	N	Digital unit	
X54-1680-00	N	Main encoder unit	
X54-1690-00	N	RIT encoder unit	
X56-1430-00	N	100W final unit	
X57-1000-11	N	Signal unit	
X57-1010-00		AT unit	

Parts No.	Re-marks	Description	Ref. No.	Q'ty
SWITCH UNIT (X41-1410-00)				
CK45B1H012K		C 0.001	C10	1
CK45E2H103P		C 0.01	C1	1
CK45F1H103Z		C 0.01	C2,5,6	3
CK45F1H103Z		C 0.01 ○	C8	1
CK45F1H473Z		C 0.047	C3,4	2
CQ92M1H153K		ML 0.015	C9	1
C91-0456-05		C 0.047	C7	1
C91-0456-05		C 0.047 ●	C8	1
E04-0152-05		UHF type receptacle ANT		1
E04-0157-05		Mini pin jack A		1
E06-0853-05		8P metal socket MIC		1
E23-0047-04		Square terminal		5
E40-0273-05		Mini connector 2P		3
E40-0274-05		Mini connector 2PL ●		2
E40-0277-05		Mini connector 2PL ○		2
E40-0473-05		Mini connector 4P		1
E40-0573-05		Mini connector 5P		2
E40-0574-05		Mini connector 5PL ●		1
E40-0577-05		Mini connector 5PL ○		1
E40-0673-05		Mini connector 6P		1
E40-0773-05		Mini connector 7P		1
E40-0874-05		Mini connector 8PL ●		1
E40-0877-05		Mini connector 8PL ○		1
G53-0511-04		Packing		2
J61-0019-05		Vinyle tie		1
L33-0658-05	N	Choke coil	L1,2	2
L40-1511-03		Ferri-inductor ●	L3	1
N14-0115-05		Flange nut		1
N15-1040-46		Flat washer		1
N30-4025-46		Round screw GND		1
R01-0406-05	N	Pot. 300Ω(B) NB LEVEL	VR8	1
R01-3422-05	N	Pot. 10kΩ(B) VOX GAIN	VR9	1
R01-3423-05	N	Pot. 10kΩ(F) NOTCH	VR6	1
R01-3424-05	N	Pot. 10kΩ(B) CW VBT	VR5	1
R01-6403-05	N	Pot. 470kΩ(B) ANTI, DELAY	VR10,11	2
R19-3413-05	N	Pot. 10kΩ(A), 10kΩ(B) AF/RF	VR7	1
R19-3414-05	N	Pot. 10kΩ(B)x2 SSB SLOPE TUNE	VR3	1
R19-9407-05	N	Pot. 10kΩ(A), 50kΩ(C) PRO., MIC/CAR	VR1,2	2
R24-9402-05	N	Pot. 10kΩ(F), 100kΩ(C)x2 PITCH/AF TUNE	VR4	1
RC05GF2H102J		Solid 1kΩ 1/2W	R26	1
RC05GF2H680J		Solid 68Ω 1/2W	R6	1
RS14AB3D470J		MF 47Ω 2W	R2,3	2
R92-0150-05		Short jumper		4
S01-1429-05	N	Rotary switch M.CH	S24	1
S01-1430-05	N	Rotary switch METER	S39	1
S01-1431-05	N	Rotary switch AGC	S40	1

PARTS LIST

Parts No.	Re-marks	Description	Ref. No.	Q'ty
S01-1432-05	N	Rotary switch FUNCTION, RF ATT	S23,25	2
S36-1408-05	N	Paddle switch CAL	S38	1
S36-2408-05	N	Paddle switch STBY, AT,PRO,TONE	S6–9	4
S40-2422-05		Push switch NOTCH,D.LOCK	S14,16	2
S40-2431-05	N	Push switch RIT	S12	1
S40-2432-05	N	Push switch T.F SET,RIT.CL	S11,13	2
S40-2433-05	N	Push switch VOX/MAN DIM/NOR,AF TUNE	S2,5,15	3
S40-2434-05	N	Push switch FULL/SEMI, MONI,VFO/MEMO, NB1,NB2	S3,4,18,21,22	5
S40-2435-05	N	Push switch A=B, MIN,MR	S17,19,20	3
S50-1409-05		Tact switch 1MHz STEP	S26,27	2
S50-1411-05	N	Tact switch BAND	S28–37	10
S51-1414-05	N	Lead relay ANT	RL2	1
S51-2412-15	N	Relay POWER	RL1	1
S90-0402-15	N	Slide switch MODE	S10	1
POWER SUPPLY UNIT (X43-1430-00)				
CE04W1E100M		E 10 25V	C11	1
CE04W1E101M		E 100 25V ●	C12	1
CE04W1E220M		E 22 25V ●	C13	1
CK45E2H472P		C 0.0047	C1,2	2
CK45F1H103Z		C 0.01	C5	1
CQ92M1H104K		ML 0.1	C7	1
C90-0858-05	N	E 2200 50V	C3,4	2
C90-0859-05	N	E 2200 35V	C6	1
C91-0456-05		C 0.047	C10	1
E40-0273-05		Mini connector 2P		3
E40-0373-05		Mini connector 3P		2
E40-0573-05		Mini connector 5P ●		1
F05-1534-05	N	Fuse 32V 15A		1
J31-0502-04		PC board collar		4
J42-0428-05		PC board bushing		4
L40-1511-03		Ferri-inductor 150μH	L1–3	3
N87-3012-46		Self tapping screw		4
R12-0427-05		Trim. pot. 500Ω(B)	VR1	1
RC05GF2H122J		Solid 1.2kΩ 1/2W	R19	1
RC05GF2H2R2J		Solid 2.2Ω 1/2W	R1,4,5	3
R92-0150-05		Short jumper		3

Parts No.	Re-marks	Description	Ref. No.	Q'ty
RF UNIT (X44-1490-00)				
C05-0030-15		Ceramic trimmer 20pF ○	TC1	1
CC45CH1H020C		C 2pF ●	C24	1
CC45RH1H050C		C 5pF	C7	1
CC45RH1H100D		C 10pF	C5,9,12	3
CC45RH1H100D		C 10pF ●	C23	1
CC45RH1H100D		C 10pF ○	C1	1
CC45RH1H560J		C 56pF ●	C22	1
CC45SL1H220J		C 22pF	C20	1
CC45SL1H470J		C 47pF ●	C1,21	2
CE04W1A470M		E 47 10V ○	C15	1
CE04W1E470M		E 47 25V	C3	1
CK45B1H102K		C 0.001	C10,11,19	3
CK45F1H103Z		C 0.01	C6,8,13,16–18	6
C91-0456-05		C 0.047	C2,4,14	3
C91-0456-05		C 0.047 ●	C15	1
E04-0157-05		Mini pin jack A		3
E29-0432-05	N	1P connector (female)		1
L19-0333-05	N	Wide bandwidth transf.	T1	1
L19-0334-05	N	Wide bandwidth transf.	T2	1
L19-0335-05	N	Wide bandwidth transf.	T6	1
L32-0199-05		OSC coil ○	T7	1
L34-0858-05		Tuning coil	T3,5	2
L34-2074-05	N	Tuning coil	T4	1
L34-2161-15		Tuning coil ●	T7	1
L40-1021-03		Ferri-inductor 1mH	L1,2	2
L40-4701-03		Ferri-inductor 47μH	L3–6	4
N87-3006-46		Self tapping screw		3
R12-0420-05		Trim. pot. 500Ω ●	VR1	1
R91-0150-05		Short jumper		3
PLL UNIT (X50-1880-00)				
C05-0030-15		Ceramic trimmer 20pF	TC3,4	2
C05-0044-05		Ceramic trimmer 30pF	TC1	1
C05-0309-05		Ceramic trimmer 40pF	TC2	1
CC45CH1H010C		C 1pF	C2,28,30,61	4
CC45CH1H020C		C 2pF	C63	1
CC45CH1H030C		C 3pF	C191	1
CC45CH1H050C		C 5pF	C62,144	2
CC45CH1H0R5C		C 0.5pF	C128,129,150, 151	4
CC45CH1H070D		C 7pF	C19	1
CC45CH1H080D		C 8pF	C101	1
CC45CH1H330J		C 33pF	C16,111	2
CC45RH1H050C		C 5pF	C127,146	2
CC45RH1H070D		C 7pF	C133,152	2
CC45RH1H150J		C 15pF	C147–149	3
CC45RH1H180J		C 18pF	C130–132	3
CC45RH1H220J		C 22pF	C27,29,31,114	4
CC45RH1H470J		C 47pF	C115	1
CC45RH1H560J		C 56pF	C113,143,145	3

PARTS LIST

Parts No.	Re-marks	Description	Ref. No.	Q'ty
CC45SL1H070D		C 7pF	C26,40,42,165,168	5
CC45SL1H100D		C 10pF	C23,99,116,117, 122,164	6
CC45SL1H101J		C 100pF	C32,180	2
CC45SL1H150J		C 15pF	C11	1
CC45SL1H151J		C 150pF	C17	1
CC45SL1H220J		C 22pF	C3,41,68,85,98, 166,167	7
CC45SL1H330J		C 33pF	C15,109,169	3
CC45SL1H560J		C 56pF	C194	1
CC45SL1H680J		C 68pF	C110	1
CC45UJ1H070D		C 7pF	C58	1
CC45UJ1H150J		C 15pF	C55	1
CC45UJ1H180J		C 18pF	C57,73	2
CC45UJ1H270J		C 27pF	C74	1
CC45UJ1H330J		C 33pF	C54,75	2
CC45UJ1H470J		C 47pF	C190	1
CC45UJ1H560J		C 56pF	C72	1
CE04W0J331M		E 330 6.3V	C14	1
CE04W1A101M		E 100 10V	C183	1
CE04W1A470M		E 47 10V	C8,70,84,176	4
CE04W1C101M		E 100 16V	C50,79	2
CE04W1C220M		E 22 16V	C53,67,76	3
CE04W1C470M		E 47 16V	C59	1
CE04W1H010M		E 1 50V	C5	1
CK45B1H102K		C 0.001	C21	1
CK45B1H222K		C 0.0022	C47,65,135	3
CK45B1H471K		C 470pF	C82,184,195,196	4
CK45F1H103Z		C 0.01	C13,18,20,22, 33–39,43–45,51, 52,56,60,64,71, 77,78,95,96,100, 102–108,112, 118–121,123–126, 134,136–142,153, 155–163,170–175, 177–179,188,189, 193	71
CQ92M1H123K		ML 0.012	C88,90	2
CQ92M1H222K		ML 0.0022	C6	1
CQ92M1H273K		ML 0.027	C89	1
CQ92M1H333K		ML 0.033	C10,48	2
CQ92M1H472K		ML 0.0047	C81	1
CQ92M1H473K		ML 0.047	C7,185	2
C91-0456-05		C 0.047	C1,4,9,12,24,25, 46,49,66,69,80, 83,86,87,91–94, 97,181,182,186, 187	23
E04-0154-05	N	Coax. connector		2
E23-0047-04		Square terminal		2
E40-0273-05		Mini connector 2P		2
E40-0373-05		Mini connector 3P		3
E40-0473-05		Mini connector 4P		1
E40-0873-05		Mini connector 8P		2
J31-0502-04		PC board collar		7
J42-0428-05		PC board bushing		7

Parts No.	Re-marks	Description	Ref. No.	Q'ty
L32-0196-05		OSC coil 20M	T14	1
L32-0649-05	N	OSC coil 50M	T15	1
L34-0709-05		Tuning coil 10M	T11,12	2
L34-0711-05		Tuning coil 14M	T7	1
L34-0712-05		Tuning coil 14M	T9	1
L34-0713-15		Tuning coil 14M	T8	1
L34-2075-05	N	Tuning coil 50M,60M	T1–6	6
L34-2076-05	N	Tuning coil 40M	T16–18	3
L34-2077-05	N	Tuning coil 8.83M	T13	1
L34-2078-05	N	Tuning coil 5M	T10	1
L40-1011-04		Ferri-inductor 100μH	L2,28	2
L40-1511-03		Ferri-inductor 150μH	L16,27,31	3
L40-2701-03		Ferri-inductor 27μH	L23,24	2
L40-4701-03		Ferri-inductor 47μH	L10–15,17,29,32	9
L40-4711-03		Ferri-inductor 470μH	L1,3–5,9,18–20, 25,26,30,35,36	13
L40-6825-04		Ferri-inductor 6.8mH	L21,22	2
L40-8291-02		Ferri-inductor 8.2μH	L6–8,33,34	5
L71-0233-05	N	MCF 8.8495MHz	MCF1,2	1A
L77-0720-05		Crystal 10.24MHz	X2	1
L77-0963-05	N	Crystal 20MHz	X1	1
R12-1408-05	N	Trim. pot. 4.7kΩ(B)	VR1,2	2
RC05GF2H390J		Solid 39Ω 1/2W	R81	1
R90-0536-05	N	Inline block 6.8kΩ×6	IB1	1
R92-0150-05		Short jumper		31

LPF UNIT (X51-1280-00)

Parts No.	Re-marks	Description	Ref. No.	Q'ty
CC45SL1H101J		C 100pF	C91	1
CC45SL2H050C		C 5pF 500V	C56	1
CC45SL2H070D		C 7pF 500V	C57	1
CC45SL2H101J		C 100pF 500V	C1,7,18,26,37, 38,55,63	8
CC45SL2H120J		C 12pF 500V	C60	1
CC45SL2H121J		C 120pF 500V	C15,25,27	3
CC45SL2H150J		C 15pF 500V	C43,61	2
CC45SL2H151J		C 150pF 500V	C6,10,21,22,31, 42	6
CC45SL2H181J		C 180pF 500V	C14,30,41	3
CC45SL2H220J		C 22pF 500V	C4	1
CC45SL2H221J		C 220pF 500V	C9,17,50,58	4
CC45SL2H330J		C 33pF 500V	C3,8,99	3
CC45SL2H331J		C 330pF 500V	C13,19,20,28,47, 52	6
CC45SL2H390J		C 39pF 500V	C100	1
CC45SL2H391J		C 390pF 500V	C16,23,33	3
CC45SL2H470J		C 47pF 500V	C2,44,45,49,59	5
CC45SL2H471J		C 470pF 500V	C24	1
CC45SL2H560J		C 56pF 500V	C62	1
CC45SL2H680J		C 68pF 500V	C46	1
CC45SL2H681J		C 680pF 500V	C36	1
CE04W1A221M		E 220 10V	C72	1
CK45F1H103Z		C 0.01	C74–78,80–86, 106	13
CK45F1H473Z		C 0.047	C66	1
CM93D2H102J		MC 0.001 500V	C51	1

PARTS LIST

Parts No.	Re-marks	Description	Ref. No.	Q'ty
CM93D2H152J		MC 0.0015 500V	C29	1
CM93D2H222J		MC 0.0022 500V	C32	1
CM93D2H821J		MC 820pF 500V	C35	1
C91-0456-05		C 0.047	C64,65,67–71,73	8
E04-0154-05		Coax. connector		3
E23-0401-05		Round terminal		8
E40-0273-05		Mini connector 2P		1
E40-0373-05		Mini connector 3P		2
E40-0473-05		Mini connector 4P		1
E40-0573-05		Mini connector 5P		2
L34-3038-05	N	Filter coil A 1.5–2.5	L9	1
L34-3039-05	N	Filter coil B 1.5–2.5	L8	1
L34-3040-05	N	Filter coil C 2.5–4.0	L12	1
L34-3041-05	N	Filter coil D 2.5–4.0	L13	1
L34-3042-05	N	Filter coil E 4.0–6.0	L6,7	2
L34-3043-05	N	Filter coil F 6.0–10.5	L3–5	3
L34-3046-05	N	Filter coil I 10.5–15.5	L10	1
L34-3047-05	N	Filter coil J 10.5–15.5	L11	1
L34-3048-15	N	Filter coil K 15.5–22.0	L14,15	2
L34-3050-05	N	Filter coil M 22.0–30.0	L1	1
L34-3051-15	N	Filter coil N 22.0–30.0	L2	1
L39-0414-05	N	Detector coil	L27,28	2
L40-1011-03		Ferri-inductor 100μH	L31,34–40	8
L40-1011-04		Ferri-inductor 100μH	L22	1
L40-1021-03		Ferri-inductor 1mH	L24,25	2
L40-1511-03		Ferri-inductor 150μH	L16–21,26	7
L40-4791-02		Ferri-inductor 4.7μH	L30	1
N30-3006-41		Round screw		2
N32-3006-41		Flat screw		2
N87-3006-46		Self tapping screw		12
RC05GF2H101J		Solid 100Ω 1/2W	R48–51	4
RC05GF2H121J		Solid 120Ω 1/2W	R53	1
RC05GF2H182J		Solid 1.8kΩ 1/2W	R30	1
RC05GF2H2R2J		Solid 2.2Ω 1/2W	R58–61	4
RC05GF2H681J		Solid 680Ω 1/2W	R17,18	2
RC05GF2H821J		Solid 820Ω 1/2W	R19,20	2
R90-0535-05	N	Resistor block 22kΩ×7	RB1,2	2
R92-0150-05		Short jumper		14
S51-1412-05	N	Relay	RL1–14	14

DIGITAL UNIT (X54-1670-00)

Parts No.	Re-marks	Description	Ref. No.	Q'ty
CC45SL1H101J		C 100pF	C15,44–46	4
CC45SL1H220J		C 22pF	C36,37	2
CC45SL1H221J		C 220pF	C39	1
CE04W0J221M		E 220 6.3V	C8,14,19	3
CE04W1A470M		E 47 10V	C21,24,42	3
CE04W1C101M		E 100 16V	C11	1
CE04W1C220M		E 22 16V	C12	1
CE04W1C471M		E 470 16V	C9	1
CE04W1E331M		E 330 25V	C6	1
CE04W1H010M		E 1 50V	C23,25	2
CE04W1H100M		E 10 50V	C2,5,40	3
CE04W1H220M		E 22 50V	C3,4	2
CK45B1H102K		C 0.001	C1,16,26–31	8
CK45F1H103Z		C 0.01	C20,50	2
CQ92M1H272K		ML 0.0027	C38	1
C90-0824-05		E 1 50V	C47–49	3
C91-0456-05		C 0.047	C7,10,13,17,18, 22,32–35,41,43	12
E29-0413-05		1P connector (female)		1
E40-0273-05		Mini connector 2P		1
E40-0373-05		Mini connector 3P		2
E40-0473-05		Mini connector 4P		2
E40-0673-05		Mini connector 6P		1
E40-0773-05		Mini connector 7P		2
E40-0873-05		Mini connector 8P		4
E40-1073-05		Mini connector 10P		1
E40-1173-05		Mini connector 11P		1
E40-1273-05		Mini connector 12P		2
J31-0502-04		PC board collar		6
J42-0404-05		PC board bushing		6
L19-0336-05	N	DC-DC transf.	T1	1
L40-1011-04		Ferri-inductor 100μH	L1–4	4
L40-1021-03		Ferri-inductor 1mH	L5–11	7
L77-0964-05	N	Crystal 5.59MHz	X1	1
N35-3006-46		Bind screw		2
N88-3008-46		Flat tapping screw		2
R90-0158-05	N	Inline block 47kΩ×7	RB3	1
R90-0162-05	N	Inline block 47kΩ×8	RB4	1
R90-0537-05	N	Inline block 10kΩ×8	RB5	1
R90-0538-05	N	Inline block 1.5kΩ×3	RB1	1
R90-0539-05	N	Inline block 47kΩ×6	RB6,7	2
R90-0542-05	N	Inline block 47kΩ×12	RB9	1
R90-0543-05	N	Inline block 47kΩ×11	RB2,8	2
R90-0544-05	N	Inline block 0.01×3	CB3	1
R90-0545-05	N	Inline block 0.01×5	CB1	1
R90-0546-05	N	Inline block 0.01×7	CB4	1
R90-0547-05	N	Inline block 0.01×12	CB2	1
R90-0548-05	N	Inline block 0.022×7	CB5	1
R90-0549-05	N	Inline block 0.022×8	CB6	1
R90-0550-05	N	Inline block 0.022×11	CB7	1

PARTS LIST

MAIN ENCODER UNIT (X54-1680-00)

Parts No.	Re-marks	Description	Ref. No.	Q'ty
CE04W0J221M		E 220 6.3V	C1	1
CE04W0J470M		E 47 6.3V	C2	1
D09-0304-04		Encoder slit		1
D21-0823-05	N	Shaft ass'y		1
E23-0015-04		Earth lug		2
G02-0519-04		Spring plate		1
J19-1342-04		Senser mounting hardware (A)		1
J19-1343-04		Senser mounting hardware (B)		1
N30-3006-46		Round screw		4
N32-3020-46		Flat screw		1
N89-3005-46		Bind tapping screw		3
R12-2409-05		Trim. pot. 5kΩ(B)	VR1,2	2

RIT ENCODER UNIT (X54-1690-00)

Parts No.	Re-marks	Description	Ref. No.	Q'ty
CE04W0J101M		E 100 6.3V	C1	1
D09-0305-04	N	Encoder slit		1
D21-0824-05	N	Shaft ass'y		1
N30-2606-46		Round screw		2
R12-2409-05		Trim. pot. 5kΩ(B)	VR1,2	2

100W FINAL UNIT (X56-1430-00)

Parts No.	Re-marks	Description	Ref. No.	Q'ty
CC45SL1H271J		C 270pF	C35	1
CC45SL1H331J		C 330pF	C2,9	2
CC45SL2H101J		C 100pF 500V	C8,40,42	3
CE04W1A471M		E 470 10V	C18	1
CE04W1H100M		E 10 50V	C12	1
CE04W1H101M		E 100 50V	C24	1
CK45B1H102K		C 0.001	C4,10,19,23,39	5
CK45F1H473Z		C 0.047	C6,7,15,22	4
CM73F2H331J	N	MC 330pF 500V	C33	1
CM73F2H391J	N	MC 390pF 500V	C38	1
CM73F2H681J	N	MC 680pF 500V	C28	1
CQ92M1H473K		ML 0.047	C21	1
C91-0456-05		C 0.047	C1,3,5,11,13,14,20,25–27,36,37	12
C91-0491-05	N	Cap. 0.0047	C16,17	2
C91-0493-05	N	Cap. 0.47	C29,30	2
E04-0157-05		Mini pin jack A		2
E23-0433-05	N	Terminal		8
E40-0373-05		Mini connector 3P		1
F01-0771-15	N	Heat sink		1
F07-0839-03	N	Heat sink cover		1
F09-0405-24		Fan		1
F20-0078-05	N	Insulating sheet		6
F29-0014-05		Shoulder washer		10
F29-0406-03		Fan motor ass'y		1
L19-0337-05	N	Input transf.	T3	1
L19-0338-05	N	Input matching transf.	T2	1
L19-0339-05	N	Output transf. B	T4	1
L19-0340-05	N	RF transf. A	T1	1
L33-0025-05		RFC 1μH	L4,5	2
L33-0032-05		RFC 3μH	L2	1
L33-0617-05		RFC	L3,7–9	4
L33-0644-05		Choke coil 2.2μH	L17	1
L33-0651-05	N	Choke coil	L14,15	2
L33-0653-05	N	Choke coil	L16	1
L33-0655-05	N	RFC	L13	1
L40-1011-04		Ferri-inductor 100μH	L10	1
L40-1511-03		Ferri-inductor 150μH	L6,11,12,18	4
N09-0623-04		Sems screw		5
N09-0643-04	N	Sems screw w. cross head		1
N09-0658-04		Round screw Fan motor		2
N15-1030-41		Washer Fan motor		4
N30-2604-41		Round screw Fan motor		5
N30-3006-46		Round screw Thermistor		1
N35-3008-46		Round screw TR		4
N87-3006-46		Self tapping screw PC board		4
N89-3006-45		Bind tapping screw Cover		10
R12-0072-05		Trim. pot. 470Ω(B)	VR1	1
R12-1406-05		Trim. pot. 1kΩ(B)	VR2	1
RC05GF2H151J		Solid 150Ω 1/2W	R7	1
RC05GF2H220J		Solid 22Ω 1/2W	R9,10	2
RC05GF2H221J		Solid 220Ω 1/2W	R11,12	2
RC05GF2H3R9J		Solid 3.9Ω 1/2W	R23–26	4
RC05GF2H4R7J		Solid 4.7Ω 1/2W	R6	1
RC05GF2H5R6J		Solid 5.6Ω 1/2W	R27–30	4
RC05GF2H560J		Solid 56Ω 1/2W	R34	1
RS14AB3D330J		MF 33Ω 2W	R35	1
R92-0041-25		Cement 0.47Ω 1W	R21	1
R92-0150-05		Short jumper		3
T42-0302-05	N	Fan motor		1

PARTS LIST

Parts No.	Re marks	Description	Ref. No.	Q'ty
SIGNAL UNIT (X57-1000-11) From S/N208XXXX–309XXXX				
C05-0013-15		Ceramic trimmer 20pF	TC3–6	4
C05-0030-15		Ceramic trimmer 20pF	TC1	1
C05-0314-05		Ceramic trimmer 100pF	TC2	1
C05-0320-05		Ceramic trimmer 30pF	TC7	1
CC45CH1H010C		C 1pF	C255	1
CC45CH1H020C		C 2pF	C471	1
CC45CH1H030C		C 3pF	C105,125,142, 280,473	5
CC45CH1H050C		C 5pF	C476	1
CC45CH1H0R5C		C 0.5pF	C199,249,356, 359,477	5
CC45CH1H070D		C 7pF	C106	1
CC45CH1H100D		C 10pF	C6,128,132,144, 310	5
CC45CH1H150J		C 15pF	C320,469	2
CC45CH1H220J		C 22pF	C340,454,456, 458,364	5
CC45RH1H010C		C 1pF	C107,121	2
CC45RH1H020C		C 2pF	C108,197,212	3
CC45RH1H030C		C 3pF	C178	1
CC45RH1H050C		C 5pF	C264	1
CC45RH1H070D		C 7pF	C184,267	2
CC45RH1H100D		C 10pF	C113–115	3
CC45RH1H101J		C 100pF	C51,66,398,308	4
CC45RH1H120J		C 12pF	C93,96,97,263, 265,296	6
CC45RH1H121J		C 120pF	C14,54,185,187, 552	5
CC45RH1H180J		C 18pF	C186	1
CC45RH1H181J		C 180pF	C45,47	2
CC45RH1H220J		C 22pF	C76,78,92,98, 266	5
CC45RH1H221J		C 220pF	C39,41	2
CC45RH1H241J		C 240pF	C301,309,553	3
CC45RH1H270J		C 27pF	C91,358	2
CC45RH1H330J		C 33pF	C348,411	2
CC45RH1H390J		C 39pF	C70,72	2
CC45RH1H470J		C 47pF	C65	1
CC45RH1H560J		C 56pF	C16,53,55,64, 71,77,370	7
CC45RH1H680J		C 68pF	C52	1
CC45RH1H820J		C 82pF	C10	1
CC45SL1H050C		C 5pF	C158,252	2
CC45SL1H100D		C 10pF	C159,336,468, 478	4
CC45SL1H101J		C 100pF	C218,283,298, 331,352,369,380, 393,466,485,487, 511,540,574,606, 654	16
CC45SL1H120J		C 12pF	C641,647	2
CC45SL1H121J		C 120pF	C24	1
CC45SL1H150J		C 15pF	C244,377	2
CC45SL1H151J		C 150pF	C338,365,373, 376,498,520,528	7
CC45SL1H220J		C 22pF	C279,483	2
CC45SL1H221J		C 220pF	C335	1
CC45SL1H330J		C 33pF	C254	1
CC45SL1H331J		C 330pF	C28,162,164, 653	4
CC45SL1H391J		C 390pF	C46,622	2

Parts No.	Re marks	Description	Ref. No.	Q'ty
CC45SL1H470J		C 47pF	C15,67,138,278, 313,472,530,656, 657	9
CC45SL1H680J		C 68pF	C13,59	2
CC45SL1H820J		C 82pF	C58,60	2
CC45TH1H030C		C 3pF	C349,462	2
CC45TH1H220J		C 22pF	C94	1
CC45TH1H270J		C 27pF	C99	1
CC45TH1H330J		C 33pF	C116	1
CC45TH1H680J		C 68pF	C464	1
CE04AW1H0R1M		E 0.1 50V	C386,510,534, 542,578	5
CE04AW1HR22M		E 0.22 50V	C86,171,486,509, 636	5
CE04W1A101M		E 100 10V	C488	1
CE04W1C100M		E 10 16V	C537,630	2
CE04W1C102M		E 1000 16V	C651	1
CE04W1C220M		E 22 16V	C151,167,221, 225,226,282,344, 392,396,450,505, 567–569,576, 583,587,631,632	1
CE04W1C221M		E 220 16V	C640	1
CE04W1C470M		E 47 16V	C222,345,346, 391,395,536,642, 648	8
CE04W1E100M		E 10 25V	C112,220,285, 343,384,387,389, 543,564,571,586, 629,633,634,639, 644,652	1
CE04W1E220M		E 22 25V	C20,22,31,38,44, 50,57,63,69,74 88	1
CE04W1E471M		E 470 25V	C440,441	2
CE04W1H010M		E 1 50V	C154,191,390, 420,423,424,426, 427,432,492,525, 541,563,565,588, 599,628,638	1
CE04W1H3R3M		E 3.3 50V	C388,449,566, 575	4
CE04W1HR47M		E 0.47 50V	C153,385,501, 591,592	5
CE04W1H4R7M		E 4.7 50V	C176,179,500	3
CK45B1H102K		C 0.001	C122,127,140, 148,152,161,163, 177,207,400,401, 436,490,532,562, 600,645,646	1
CK45B1H181K		C 180pF	C100	1
CK45B1H221K		C 220pF	C412,531,595, 596,618	5
CK45B1H222K		C 0.0022	C227,228,533, 549,614,623	6
CK45B1H331K		C 330pF	C465	
CK45B1H391K		C 390pF	C32,34	
CK45B1H471K		C 470pF	C339,353,434	
CK45B1H681K		C 680pF	C33,330,394,570	4
CK45B1H821K		C 820pF	C23,29,40	
CK45E2H102P		C 0.001 500V	C135	

PARTS LIST

Parts No.	Re marks	Description	Ref. No.	Q'ty
CK45F1H103Z		C 0.01	C7,11,12,17,90,95, 102,104,111,117,118, 120,123,129,134,141, 143,145,146,166,172, 173,174,183,194,195, 208,209,219,236,237, 241,242,253,262,269, 271,277,281,284,324, 351,355,361,367,378, 413,430,435,437,439, 443,444,452,453,455, 457,459,461,475,493, 497,515,521,527,535, 539,544,547,559,561, 577,584,607–609, 655	77
CQ09S1H122J		S 0.0012	C402–404	3
CQ09S1H182J		S 0.0018	C518,519	2
CQ09S1H392J		S 0.0039	C554,610	2
CQ92M1H102K		ML 0.001	C26,170,213	3
CQ92M1H103K		ML 0.01	C168,447,448,451	4
CQ92M1H104K		ML 0.1	C643	1
CQ92M1H152K		ML 0.0015	C25,27,616	3
CQ92M1H222K		ML 0.0022	C545,546,637	3
CQ92M1H223K		ML 0.022	C215,229,230,232, 446,538,572,649	8
CQ92M1H332K		ML 0.0033	C579–581	3
CQ92M1H392K		ML 0.0039	C512,615	2
CQ92M1H472K		ML 0.0047	C110,589	2
CQ92M1H473K		ML 0.047	C214,216,217,231, 233–235,491,582, 598,625,635	12
CQ92M1H562K		ML 0.0056	C224,590	2
CQ92M1H682K		ML 0.0068	C626,627	2
C90-0817-05		E 1000 16V	C119	1
C91-0456-05		C 0.047	C8,9,18,19,21,30, 37,42,43,48,49,62, 80–85,87,89,109, 149,156,157,165,175, 180–182,190,192, 193,210,223,245,248, 256,258,259,274,295, 297,300,311, 314–317,325,327,329 332–334,341,342, 347,362,366,368,372, 374,375,379, 381–383,397,399, 414–418,421,422, 425,428,429,433,438, 463,480,482,484,489, 494–496,499,513, 514,516,517, 522–524,529,548, 550,551,555–558, 560,585,593,594,597, 611–613,617, 619–621,624	118

Parts No.	Re marks	Description	Ref. No.	Q'ty
C91-0457-05		C 0.022	C56,61,68,73,75 79,124,126,130, 131,133,136,137, 139,150,155,160, 238–240,243,246 247,250,251,257 260,261,270,272, 273,276,286–294, 299,312,318, 321–323,326,328, 337,350,354,357, 360,363,419,431, 442,445,460,467, 470,474,479,481	65
C91-0458-05		Laminated cap. 0.47	C169	1
C91-0472-05		ML 0.1	C211	1
E04-0154-05		Coax. connector		8
E23-0512-05		Round terminal		1
E40-0273-05		Mini connector 2P		12
E40-0373-05		Mini connector 3P		2
E40-0473-05		Mini connector 4P		5
E40-0511-05		Mini connector 5P	MC1–6	6
E40-0517-05		Mini connector 5P	MB1,2	2
E40-0573-05		Mini connector 5P		1
E40-0673-05		Mini connector 6P		4
E40-0773-05		Mini connector 7P		1
E40-0873-05		Mini connector 8P		3
E40-1073-05		Mini connector 10P		2
E40-1173-05		Mini connector 11P		1
F20-0525-05		Insulating sheet		3
F29-0014-05		Shoulder washer		3
L19-0324-05		Wide bandwidth transf.	L13,51,93	3
L30-0516-05	N	IFT	L140	1
L32-0201-05		OSC coil CAR1,CAR2	L139,161	2
L32-0650-15	N	OSC coil 100kHz	L166,169,172, 173	4
L32-0651-05	N	OSC coil VCO-L	L54	1
L32-0652-05	N	OSC coil VCO-M	L53	1
L32-0653-05	N	OSC coil VCO-H	L52	1
L33-0656-05	N	Choke coil 25μH	L160	1
L33-0657-05	N	Choke coil 27μH	L137	1
L34-0535-05		Tuning coil	L80,111,115	3
L34-0536-05		Tuning coil 8.83MHz	L81,113,126,143	4
L34-0540-05		Tuning coil	L135,136,144, 145,152	5
L34-0664-05		Tuning coil 455kHz	L130,153	2
L34-0858-05		Tuning coil	L124	1
L34-0859-05		Tuning coil	L121,123	2
L34-0860-15		Tuning coil	L122	1
L34-0941-05		Tuning coil 8.83MHz	L127	1
L34-0943-05		Tuning coil	L99,125,129,133	4
L34-0997-05		Tuning coil	L128	1
L34-2079-05	N	Tuning coil	L11	1
L34-2080-05	N	Tuning coil	L12	1
L34-2081-05	N	Tuning coil	L15	1
L34-2082-05	N	Tuning coil	L16	1
L34-2083-05	N	Tuning coil	L18	1
L34-2085-05	N	Tuning coil	L22	1
L34-2086-05	N	Tuning coil	L23	1
L24-2087-05	N	Tuning coil	L24	1
L34-2088-05	N	Tuning coil	L25	1

PARTS LIST

Parts No.	Re-marks	Description	Ref. No.	Q'ty
L34-2089-05	N	Tuning coil	L26	1
L34-2090-05	N	Tuning coil	L27	1
L34-2091-05	N	Tuning coil	L29	1
L34-2092-05	N	Tuning coil	L30	1
L34-2093-05	N	Tuning coil	L31,32	2
L34-2094-05	N	Tuning coil	L33	1
L34-2095-15	N	Tuning coil	L34	1
L34-2096-05	N	Tuning coil	L35	1
L34-2097-05	N	Tuning coil	L17	1
L34-2098-05	N	Tuning coil	L19	1
L34-2099-05	N	Tuning coil	L38,39	2
L34-2100-25	N	Tuning coil	L40	1
L34-2101-05	N	Tuning coil	L41	1
L34-2102-25	N	Tuning coil	L42	1
L34-2103-15	N	Tuning coil	L43	1
L34-2104-05	N	Tuning coil	L44	1
L34-2105-15	N	Tuning coil	L45	1
L34-2106-05	N	Tuning coil	L66,68	2
L34-2107-05	N	Tuning coil	L67	1
L34-2108-15	N	Tuning coil	L77	1
L34-2109-15	N	Tuning coil	L84	1
L34-2111-05	N	Tuning coil	L88,92	2
L34-2112-05	N	Tuning coil	L89,91	2
L34-2113-05	N	Tuning coil	L90	1
L34-2114-15	N	Tuning coil 44.93MHz	L94	1
L34-2115-15	N	Tuning coil 44.93MHz	L95	1
L34-2116-15	N	Tuning coil 44.93MHz	L96,97	2
L34-2117-15	N	Tuning coil	L98	1
L34-2118-15	N	Tuning coil 8.83MHz	L112	1
L34-2121-05	N	Tuning coil 455kHz	L131	1
L34-2122-05	N	Tuning coil 455kHz	L134	1
L34-2123-15	N	Tuning coil	L132,142	2
L34-2124-05	N	Tuning coil 455kHz	L165	1
L34-2125-15	N	Tuning coil 355kHz	L146–148	3
L34-2127-15	N	Tuning coil	L167	1
L34-2128-15	N	Tuning coil	L168	1
L34-2129-05	N	Tuning coil	L175	1
L40-1011-03		Ferri-inductor 100μH	L83	1
L40-1011-04		Ferri-inductor 100μH	L82,87,101	3
L40-1021-03		Ferri-inductor 1mH	L149–151	3
L40-1511-03		Ferri-inductor 150μH	L2,118,119	3
L40-1541-27		Ferri-inductor 150mH	L170,171	2
L40-1811-03		Ferri-inductor 180μH	L86	1
L40-2201-03		Ferri-inductor 22μH	L55,56	2
L40-2291-02		Ferri-inductor 2.2μH	L36	1
L40-2701-03		Ferri-inductor 27μH	L57,58	2
L40-3301-03		Ferri-inductor 33μH	L59,60	2
L40-3391-03		Ferri-inductor 3.3μH	L174	1
L40-4701-03		Ferri-inductor 47μH	L65,69–73,76, 78,79	9
L40-4701-11		Ferri-inductor 47μH	L120	1
L40-4711-03		Ferri-inductor 470μH	L46–50,61–64,74, 75,100,114,116, 117,138,141,154–159, 162–164,176	27
L40-4725-04		Ferri-inductor 4.7mH	L14	1
L40-4791-02		Ferri-inductor 4.7μH	L10,37	2
L40-5691-02		Ferri-inductor 5.6μH	L85	1
L40-8291-02		Ferri-inductor 8.2μH	L28	1
L71-0234-05	N	MCF 44.93MHz	XF1,2	1A
L71-0235-05	N	MCF 8.830MHz	XF3	1
L72-0319-05		Ceramic filter 455kHz	CF2	1
L72-0334-05	N	Ceramic filter 455kHz	CF1	1

Parts No.	Re-marks	Description	Ref. No.	Q'ty
L77-0965-15	N	Crystal 36.1MHz	X1	1
L77-0966-05	N	Crystal 8375kHz	X2	1
L77-0967-05	N	Crystal 8828.5kHz	X4	1
L77-0968-05	N	Crystal 8830kHz	X5	1
L77-0969-05	N	Crystal 8831.5kHz	X3	1
N10-2030-41		Nut		6
N30-3008-41		Round screw		4
N30-3010-41		Round screw		8
N87-3006-41		Self tapping screw		3
R12-0401-05		Trim. pot. 100Ω	VR21	1
R12-0420-05		Trim. pot. 500Ω	VR2,6	2
R12-0430-05	N	Trim. pot. 470Ω	VR3–5	3
R12-1405-05		Trim. pot. 1kΩ	VR18	1
R12-1424-05	N	Trim. pot. 4.7kΩ	VR23,24,27	3
R12-2409-05		Trim. pot. 5kΩ	VR1	1
R12-3411-05		Trim. pot. 47kΩ	VR8–10,15,16 26,32–34	9
R12-3413-05		Trim. pot. 10kΩ	VR11,13,25,30	4
R12-3430-05		Trim. pot. 10kΩ	VR22	1
R12-3438-05	N	Trim. pot. 22kΩ	VR7,28,29	3
R12-5414-05	N	Trim. pot. 100kΩ	VR12,17,31	3
R12-5415-05	N	Trim. pot. 150kΩ	VR20	1
R12-6404-05		Trim. pot. 470kΩ	VR14,19	2
RN14BK2E103F		MF 10kΩ 1/4W	R277	1
RN14BK2E271F		MF 270Ω 1/4W	R519,520	2
RN14BK2E333F		MF 33kΩ 1/4W	R272,275	2
RN14BK2E912F		MF 9.1kΩ 1/4W	R273	1
RN14BK2E1503F		MF 150kΩ 1/4W	R276	1
RS14AB3A331J		MF 330Ω 1W	R20	1
R90-0163-05	N	Inline block 47kΩ x 9	IB1	1
R90-0549-05	N	Inline block 0.022 x 8	IB4	1
R90-0551-05	N	Inline block 0.01 x 4	IB2,3	2
R90-0553-05	N	Inline block	IB5	1
R92-0150-05		Short jumper		157
S51-1404-05		Relay	RL1–3	3

SIGNAL UNIT (X57-1000-11) From S/N310XXXX–

Parts No.	Re-marks	Description	Ref. No.	Q'ty
C05-0013-15		Ceramic trimmer 20pF	TC3–6	4
C05-0030-15		Ceramic trimmer 20pF	TC1	1
C05-0314-05		Ceramic trimmer 100pF	TC2	1
CC45CH1H010C		C 1pF	C255,476	2
CC45CH1H020C		C 2pF	C471	1
CC45CH1H030C		C 3pF	C105,125,142, 280,469	5
CC45CH1H0R5C		C 0.5pF	C199,249,356, 359,473,477	6
CC45CH1H070D		C 7pF	C106	1
CC45CH1H100D		C 10pF	C6,128,132,144, 310	5
CC45CH1H150J		C 15pF	C254	1
CC45CH1H220J		C 22pF	C454,456,458, 364	4

PARTS LIST

Parts No.	Re-marks	Description	Ref. No.	Q'ty
CC45RH1H010C		C 1pF	C107,121	2
CC45RH1H020C		C 2pF	C108,197,212	3
CC45RH1H030C		C 3pF	C178	1
CC45RH1H050C		C 5pF	C264	1
CC45RH1H070D		C 7pF	C184,267	1
CC45RH1H100D		C 10pF	C113–115	3
CC45RH1H101J		C 100pF	C51,66,398	3
CC45RH1H120J		C 12pF	C93,96,97,263,256,296	6
CC45RH1H121J		C 120pF	C14,54,185,187,552	5
CC45RH1H180J		C 18pF	C186	1
CC45RH1H181J		C 180pF	C45,47	2
CC45RH1H220J		C 22pF	C76,78,92,98 266,319,320	7
CC45RH1H221J		C 220pF	C39,41	2
CC45RH1H241J		C 240pF	C301,309,553	3
CC45RH1H270J		C 27pF	C91,358	2
CC45RH1H330J		C 33pF	C348,411	2
CC45RH1H390J		C 39pF	C70,72	2
CC45RH1H470J		C 47pF	C65	1
CC45RH1H560J		C 56pF	C16,53,55,64,71,77,370	7
CC45RH1H680J		C 68pF	C52	1
CC45RH1H820J		C 82pF	C10	1
CC45SL1H050C		C 5pF	C158,252	2
CC45SL1H100D		C 10pF	C159,336,468,478	4
CC45SL1H101J		C 100pF	C218,283,298,308,331,352,369,380,393,466,483,485,511,540,574,606,654	17
CC45SL1H120J		C 12pF	C641,647	2
CC45SL1H121J		C 120pF	C24	1
CC45SL1H150J		C 15pF	C377	1
CC45SL1H151J		C 150pF	C338,365,373,376,498,520,528	7
CC45SL1H220J		C 22pF	C279	1
CC45SL1H221J		C 220pF	C335	1
CC45SL1H330J		C 33pF	C254	1
CC45SL1H331J		C 330pF	C28,162,164,653	4
CC45SL1H391J		C 390pF	C46,622	2
CC45SL1H470J		C 47pF	C15,67,138,278,313,472,530,657	8
CC45SL1H680J		C 68pF	C13,59	2
CC45SL1H820J		C 82pF	C58,60	2
CC45TH1H030C		C 3pF	C349,462	2
CC45TH1H220J		C 22pF	C94	1
CC45TH1H270J		C 27pF	C99	1
CC45TH1H330J		C 33pF	C116	1
CC45UJ1H820J		C 82pF	C464	1
CE04AW1H0R1M		E 0.1 50V	C385,386,510,534,542,578	6
CE04AW1HR22M		E 0.22 50V	C86,171,509,636	4
CE04W1HR33M		E 0.33 50V	C355,459	2
CE04W1A101M		E 100 10V	C488	1
CE04W1C100M		E 10 16V	C396,537,630	3
CE04W1C101M		E 100 16V	C525	1
CE04W1C102M		E 1000 16V	C651	1
CE04W1C220M		E 22 16V	C151,167,221,225,226,282,344,392,396,450,505,567–596,576,583,587,631,632	19
CE04W1C221M		E 220 16V	C640	1
CE04W1C470M		E 47 16V	C222,345,346,391,395,536,613,642,648	9
CE04W1E100M		E 10 25V	C112,220,285,343,384,387,389,543,564,571,586,629,633,634,639,644,652	17
CE04W1E220M		E 22 25V	C20,22,31,38,44,50,57,63,69,74,88	11
CE04W1E471M		E 470 25V	C440,441	2
CE04W1H010M		E 1 50V	C154,191,375,390,420,423,424,426,427,432,486,492,494,541,563,565,588,599,628,638	20
CE04W1H3R3M		E 3.3 50V	C388,449,566,575	4
CE04W1HR47M		E 0.47 50V	C153,101,501,591,592	5
CE04W1H4R7M		E 4.7 50V	C176,179,500	3
CK45B1H102K		C 0.001	C17,122,127,140,146,148,152,161,163,177,207,367,371,400,401,436,487,490,532,562,600,645,646	23
CK45B1H181K		C 180pF	C100	1
CK45B1H221K		C 220pF	C531,595,596,618	4
CK45B1H222K		C 0.0022	C227,228,533,549,614,623	6
CK45B1H331K		C 330pF	C412,465	2
CK45B1H391K		C 390pF	C32,34	2
CK45B1H471K		C 470pF	C339,353,434	3
CK45B1H681K		C 680pF	C33,330	2
CK45B1H821K		C 820pF	C23,29,40	3
CK45E2H102P		C 0.001 500V	C135	1
CK45F1H103Z		C 0.01	C1,7,11,12,95,102,104,111,117,118,120,123,129,134,141,143,145,166,172–174,183,194,195,208,209,219,236,237,242,253,262,269,271,277,281,284,324,351,361,378,413,430,435,437,439,443,444,452,453,455,457,461,475,493,497,515,521,527,535,539,544,559,561,577,584,607–609,655	70

PARTS LIST

Parts No.	Re marks	Description	Ref. No.	Q'ty
CQ09S1H122J		S 0.0012	C402–404	3
CQ09S1H182J		S 0.0018	C518,519	2
CQ09S1H392J		S 0.0039	C544,610	2
CQ92M1H102K		ML 0.001	C26,170,	2
CQ92M1H103K		ML 0.01	C168,447,448,451	4
CQ92M1H104K		ML 0.1	C643	1
CQ92M1H152K		ML 0.0015	C25,27,616	3
CQ92M1H222K		ML 0.0022	C546,637	2
CQ92M1H223K		ML 0.022	C215,229,230,232, 446,538,572,649	8
CQ92M1H332K		ML 0.0033	C394,570,579–581	5
CQ92M1H392K		ML 0.0039	C512,615	2
CQ92M1H472K		ML 0.0047	C110,589	2
CQ92M1H473K		ML 0.047	C214,216,217,231, 233–235,491,582, 598,625,635	12
CQ92M1H562K		ML 0.0056	C224,590	2
CQ92M1H682K		ML 0.0068	C626,627	2
C90-0817-05		E 10000 16V	C119	1
C90-0878-05		T 1 35V	C700–702	3
C91-0456-05		C 0.047	C2,5,8,9,18,19,21,30, 37,42,43,48,49,62, 80–85,87,89,109,149, 156,157,165,175,180–182,190,192,193,206, 210,223,245,248,256, 258,259,274,295,297, 300,302,311,314–317, 325,327,329,332–334, 341,342,347,362,366, 368,372,374,379,381–383,397,399,405,414–418,421,422,425,428, 429,433,438,463,480, 482,484,489,495,496, 499,508,513,514,516, 517,522–524,526,529, 548,550,551,555–558, 560,585,593,594,597, 605,611,612,617,619, 621,624	122
C91-0457-05		C 0.022	C56,61,68,73,75 79,124,126,130, 131,133,136,137, 139,150,155,160, 238–240,243,246, 247,250,251,257, 260,261,270,272, 273,276,286–294, 299,312,318, 321–323,328,337, 350,354,357,360, 363,419,431,442, 445,460,467,470, 474,479,481	64
C91-0458-05		Laminated cap. 0.47	C169	1
C91-0472-05		ML 0.1	C211	1
E04-0154-05		Coax. connector		8
E23-0512-05		Round terminal		1
E40-0273-05		Mini connector 2P		12
E40-0373-05		Mini connector 3P		2
E40-0473-05		Mini connector 4P		5
E40-0511-05		Mini connector 5P	MC1–6	6
E40-0517-05		Mini connector 5P	MB1,2	2
E40-0573-05		Mini connector 5P		1
E40-0673-05		Mini connector 6P		4
E40-0773-05		Mini connector 7P		1
E40-0873-05		Mini connector 8P		3
E40-1073-05		Mini connector 10P		2
E40-1173-05		Mini connector 11P		1
F11-0813-04	N	Shield cover	CAR1	1
F20-0525-05		Insulating sheet		3
F29-0014-05		Shoulder washer		3
L19-0324-05		Wide bandwidth transf.	L13,51,93	3
L30-0516-05	N	IFT	L140	1
L32-0201-05		OSC coil CAR1,CAR2	L139,161	2
L32-0650-15	N	OSC coil 100kHz	L166,169,172, 173	4
L32-0651-05	N	OSC coil VCO-L	L54	1
L32-0652-05	N	OSC coil VCO-M	L53	1
L32-0653-05	N	OSC coil VCO-H	L52	1
L33-0656-05	N	Choke coil 25μH	L160	1
L33-0657-05	N	Choke coil 27μH	L137	1
L34-0535-05		Tuning coil	L80,111,115	3
L34-0536-05		Tuning coil 8.83MHz	L81,113,126,143	4
L34-0540-05		Tuning coil	L135,136,144, 145,152	5
L34-0664-05		Tuning coil 455kHz	L130,153	2
L34-0858-05		Tuning coil	L124	1
L34-0859-05		Tuning coil	L121,123	2
L34-0860-15		Tuning coil	L122	1
L34-0941-05		Tuning coil 8.83MHz	L127	1
L34-0943-05		Tuning coil	L99,125,129,133	4
L34-0997-05		Tuning coil	L128	1
L34-2079-05	N	Tuning coil	L11	1
L34-2080-05	N	Tuning coil	L12	1
L34-2081-05	N	Tuning coil	L15	1
L34-2082-05	N	Tuning coil	L16	1
L34-2083-05	N	Tuning coil	L18	1
L34-2085-05	N	Tuning coil	L22	1
L34-2086-05	N	Tuning coil	L23	1
L34-2087-05	N	Tuning coil	L24	1
L34-2088-05	N	Tuning coil	L25	1
L34-2089-05	N	Tuning coil	L26	1
L34-2090-05	N	Tuning coil	L27	1
L34-2091-05	N	Tuning coil	L29	1
L34-2092-05	N	Tuning coil	L30	1
L34-2093-05	N	Tuning coil	L31,32	2
L34-2094-05	N	Tuning coil	L33	1
L34-2095-15	N	Tuning coil	L34	1
L34-2096-05	N	Tuning coil	L35	1
L34-2097-05	N	Tuning coil	L17	1
L34-2098-05	N	Tuning coil	L19	1
L34-2099-05	N	Tuning coil	L38,39	2
L34-2100-25	N	Tuning coil	L40	1
L34-2101-05	N	Tuning coil	L41	1
L34-2102-25	N	Tuning coil	L42	1
L34-2103-15	N	Tuning coil	L43	1
L34-2104-05	N	Tuning coil	L44	1
L34-2105-15	N	Tuning coil	L45	1
L34-2106-05	N	Tuning coil	L66,68	2
L34-2107-15	N	Tuning coil	L67	1

PARTS LIST

Parts No.	Re marks	Description	Ref. No.	Q'ty
L34-2108-15	N	Tuning coil	L77	1
L34-2109-15	N	Tuning coil	L84	1
L34-2111-05	N	Tuning coil	L88,92	2
L34-2112-05	N	Tuning coil	L89,91	2
L34-2113-05	N	Tuning coil	L90	1
L34-2114-15	N	Tuning coil 44.93MHz	L94	1
L34-2115-15	N	Tuning coil 44.93MHz	L95	1
L34-2116-15	N	Tuning coil 44.93MHz	L96,97	2
L34-2117-15	N	Tuning coil	L98	1
L34-2118-15	N	Tuning coil 8.83MHz	L112	1
L34-2121-05	N	Tuning coil 455kHz	L131	1
L34-2122-05	N	Tuning coil 455kHz	L134	1
L34-2123-15	N	Tuning coil	L132,142	2
L34-2124-05	N	Tuning coil 455kHz	L165	1
L34-2125-15	N	Tuning coil 355kHz	L146–148	3
L34-2127-15	N	Tuning coil	L167	1
L34-2128-15	N	Tuning coil	L168	1
L34-2129-05	N	Tuning coil	L175	1
L40-1011-03		Ferri-inductor 100μH	L83	1
L40-1011-04		Ferri-inductor 100μH	L82,87,101	3
L40-1021-03		Ferri-inductor 1mH	L3,149–151	4
L40-1511-03		Ferri-inductor 150μH	L2,118,119	3
L40-1541-27		Ferri-inductor 150mH	L170,171	2
L40-1811-03		Ferri-inductor 180μH	L86	1
L40-2201-03		Ferri-inductor 22μH	L55,56	2
L40-2291-02		Ferri-inductor 2.2μH	L36	1
L40-2701-03		Ferri-inductor 27μH	L57,58	2
L40-3301-03		Ferri-inductor 33μH	L59,60	2
L40-3391-03		Ferri-inductor 3.3μH	L174	1
L40-4701-03		Ferri-inductor 47μH	L65,69–73,76, 78,79	9
L40-4701-11		Ferri-inductor 47μH	L120	1
L40-4711-03		Ferri-inductor 470μH	L1,4,46–50, 61–64,74,75,110, 114,116,117,138, 141,154–159, 162–164,176	29
L40-4725-04		Ferri-inductor 4.7mH	L14	1
L40-4791-02		Ferri-inductor 4.7μH	L10,37	2
L40-5691-02		Ferri-inductor 5.6μH	L85	1
L40-8291-02		Ferri-inductor 8.2μH	L28	1
L71-0234-05	N	MCF 44.93MHz	XF1,2	1A
L71-0235-05	N	MCF 8.830MHz	XF3	1
L72-0319-05		Ceramic filter 455kHz	CF2	1
L72-0334-05	N	Ceramic filter 455kHz	CF1	1
L77-0965-15	N	Crystal 36.1MHz	X1	1
L77-0966-05	N	Crystal 8375kHz	X2	1
L77-0967-05	N	Crystal 8828.5kHz	X4	1
L77-0968-05	N	Crystal 8830kHz	X5	1
L77-0969-05	N	Crystal 8831.5kHz	X3	1
N10-2030-41		Nut		6
N30-3008-41		Round screw		4
N30-3010-41		Round screw		8
N87-3006-41		Self tapping screw		3
R12-0401-05		Trim. pot. 100Ω	VR21	1
R12-0420-05		Trim. pot. 500Ω	VR2,6	2
R12-0430-05	N	Trim. pot. 470Ω	VR3	1
R12-0531-05		Trim. pot. 500Ω	VR18	1
R12-1405-05		Trim. pot. 1kΩ	VR33	1
R12-1424-05	N	Trim. pot. 4.7kΩ	VR23,24,27	3

Parts No.	Re marks	Description	Ref. No.	Q'ty
R12-2409-05		Trim. pot. 5kΩ	VR1	1
R12-3411-05		Trim. pot. 47kΩ	VR8–10,15,16 26,28,32,34	9
R12-3413-05		Trim. pot. 10kΩ	VR11,13,25,30	4
R12-3438-05	N	Trim. pot. 22kΩ	VR7,29	2
R12-5414-05	N	Trim. pot. 100kΩ	VR12,17,31	3
R12-5415-05	N	Trim. pot. 150kΩ	VR20	1
R12-6404-05		Trim. pot. 470kΩ	VR14,19	2
RN14BK2E103F		MF 10kΩ 1/4W	R272,275,277	3
RN14BK2E271F		MF 270Ω 1/4W	R519,520	2
RN14BK2E912F		MF 9.1kΩ 1/4W	R273	1
RN14BK2E1503F		MF 150kΩ 1/4W	R276	1
RS14AB3A331J		MF 330Ω 1W	R20	1
R90-0163-05	N	Inline block 47kΩx9	IB1	1
R90-0549-05	N	Inline block 0.022x8	IB4	1
R90-0551-05	N	Inline block 0.01x4	IB2,3	2
R90-0553-05	N	Inline block	IB5	1
R92-0150-05		Short jumper		142
S51-1404-05		Relay	RL1–3	3

AT UNIT (X57-1010-00)

Parts No.	Re marks	Description	Ref. No.	Q'ty
C02-0022-05	N	Variable cap.	VC1,2	2
C05-0315-05		Ceramic trimmer 60pF	TC1	1
CE04W0J101M		E 100 6.3V	C19,21	2
CE04W1C100M		E 10 16V	C47	1
CE04W1E220M		E 22 25V	C31	1
CE04W1E470M		E 47 25V	C18,20	2
CE04W1H101M		E 100 50V	C32	1
CC45SL2H121J		C 120pF 500V	C29	1
CC45SL2H151J		C 150pF 500V	C30	1
CK45B1H102K		C 0.001	C25,26,37–40, 44,45	8

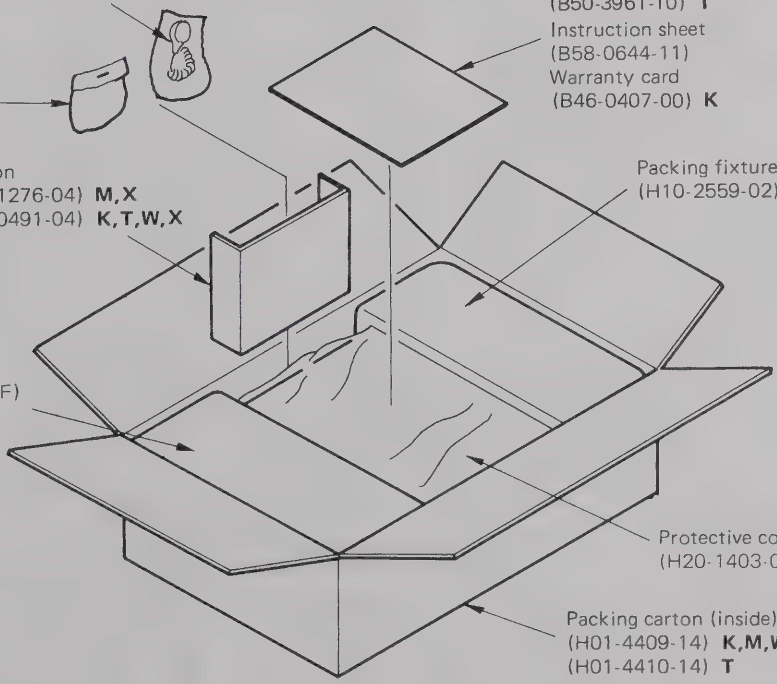
PARTS LIST/PACKING

Parts No.	Re marks	Description	Ref. No.	Q'ty
CK45F1H103Z		C 0.01	C1–6,8–17 33–36,46	22
CQ92M1H333K		ML 0.033	C43	1
C91-0456-05		C 0.047	C22,23,27,28,42	5
D22-0408-05	N	Coupling		2
D40-0623-25	N	Gear ass'y		1
D40-0624-25	N	Gear ass'y		1
E04-0154-05		Coax. connector		6
E40-0473-05		Mini connector 4P		2
E40-0673-05		Mini connector 6P		2
E40-0873-05		Mini connector 8P		1
J31-0502-04		PC board collar		6
J42-0428-05		PC board bushing		6
L34-2133-15	N	Tuning coil A	L20	1
L34-2134-05	N	Tuning coil B	L19	1
L39-0415-15	N	Detector coil A	L18	1
L39-0416-05	N	Detector coil B	L17	1
L40-1011-04		Ferri-inductor 100μH	L13,14,21	3
L40-1011-12		Ferri-inductor 100μH	L8–11	4
L40-1511-03		Ferri-inductor 150μH	L12,22–25	5
L40-4711-03		Ferri-inductor 470μH	L1–6,15	7
L40-4711-12		Ferri-inductor 470μH	L7,16	2
L92-0103-05		Toroid core		2
L92-0115-05	N	Toroid core		1
N09-0256-05		Gnd. screw		1
N10-2030-46		Nut		1

Parts No.	Re marks	Description	Ref. No.	Q'ty
N30-3006-46		Round screw		1
N35-3006-41		Bind screw		4
N87-3006-41		Self tapping screw		7
N87-3012-41		Self tapping screw		6
N88-3008-41		Flat tapping screw		10
R12-2401-05		Trim. pot. 5kΩ	VR1	1
R12-3401-05		Trim. pot. 10kΩ	VR2	1
RC05GF2H101J		Solid 100Ω 1/2W	R112,113	2
RC05GF2H151J		Solid 150Ω 1/2W	R150	1
RC05GF2H270J		Solid 27Ω 1/2W	R46,49,62,65	4
RN14BK2E103F		MF 10kΩ 1/4W	R96,97,100,101	4
RS14AB3A102J		MF 1kΩ 1W	R129,131	2
RS14AB3A271J		MF 270Ω 1W	R75	1
RS14AB3A330J		MF 33Ω 1W	R132	1
RS14AB3A390J		MF 39Ω 1W	R92	1
RS14AB3D271J		MF 270Ω 2W	R76	1
R90-0554-05		Inline block	IB1	1
R90-0555-05	N	Inline block	IB2	1
	N			
R92-0150-05		Short jumper		37
S51-1412-05		Relay	RL2–6	5
S51-2408-05		Relay	RL9	1
S51-2411-05	N	Relay	RL1,8	2
T42-0303-05	N	Motor		2

PACKING

Protective bag (H25-0105-04)
- AC cord ass'y (E30-1643-15) **K,M**
- AC cord ass'y (E30-1644-15) **T**
- AC cord ass'y (E30-1645-05) **W**
- AC cord ass'y (E30-1647-05) **X**
- Protective bag (H25-0120-04)
  - 7P DIN plug (E07-0751-05)
  - Phone plug (E12-0001-15)
  - Fuse 4A (F05-4022-05) **M,T,W,X**
  - Fuse 6A (F05-6021-05) **K,M**
  - Protective bag **K,T,W**
    - 8P metal socket (E07-0852-05) **K,T,W**



Microphone
(T91-0316-15) **M,X**

Instruction manual
(B50-3959-20) **K,M,W,X**
(B50-3961-10) **T**
Instruction sheet
(B58-0644-11)
Warranty card
(B46-0407-00) **K**

Cushion
(H10-1276-04) **M,X**
(H12-0491-04) **K,T,W,X**

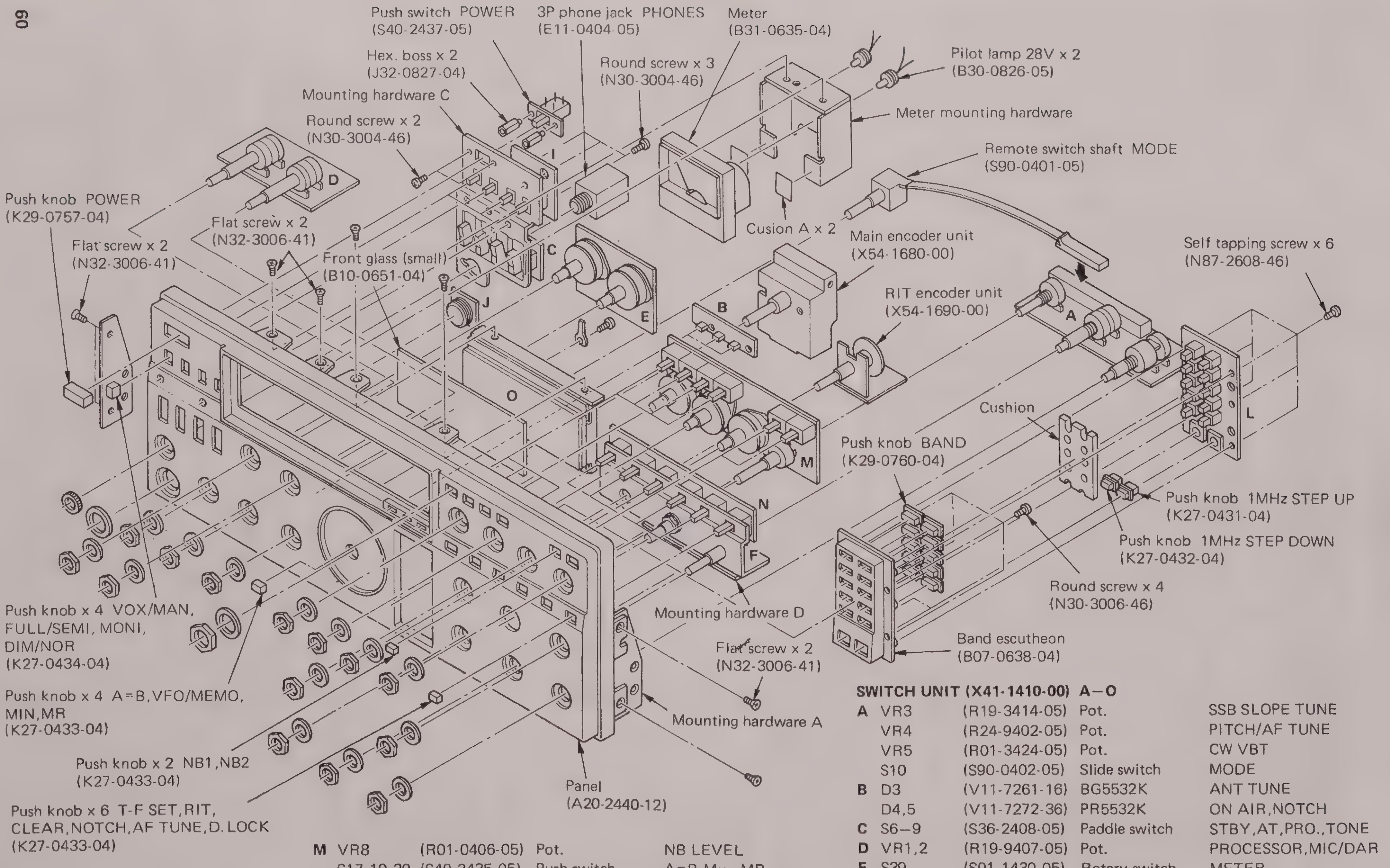
Packing fixture (R)
(H10-2559-02)

Packing fixture (F)
(H10-2558-02)

Protective cover
(H20-1403-03)

Packing carton (inside)
(H01-4409-14) **K,M,W,X**
(H01-4410-14) **T**

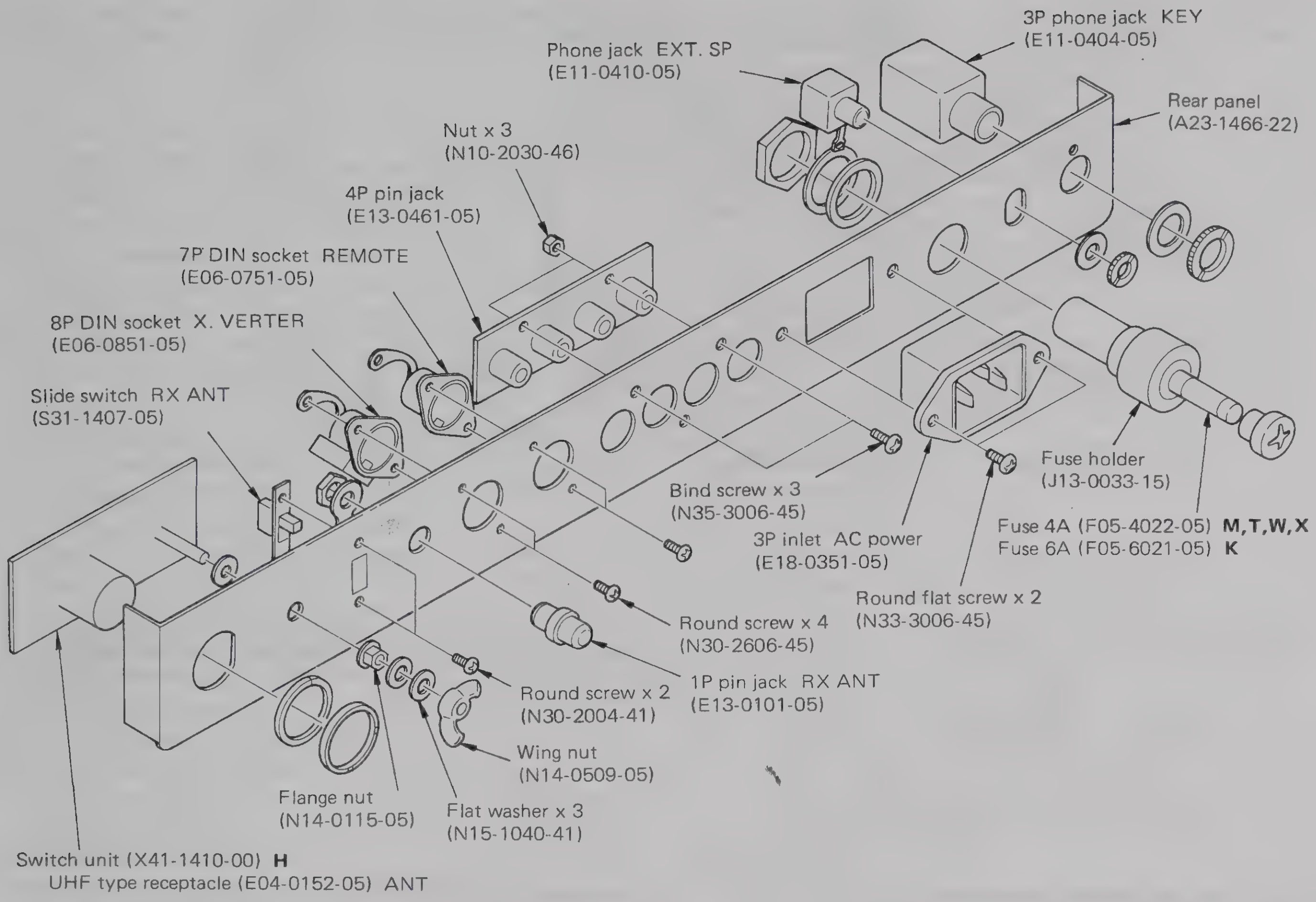
DISASSEMBLY

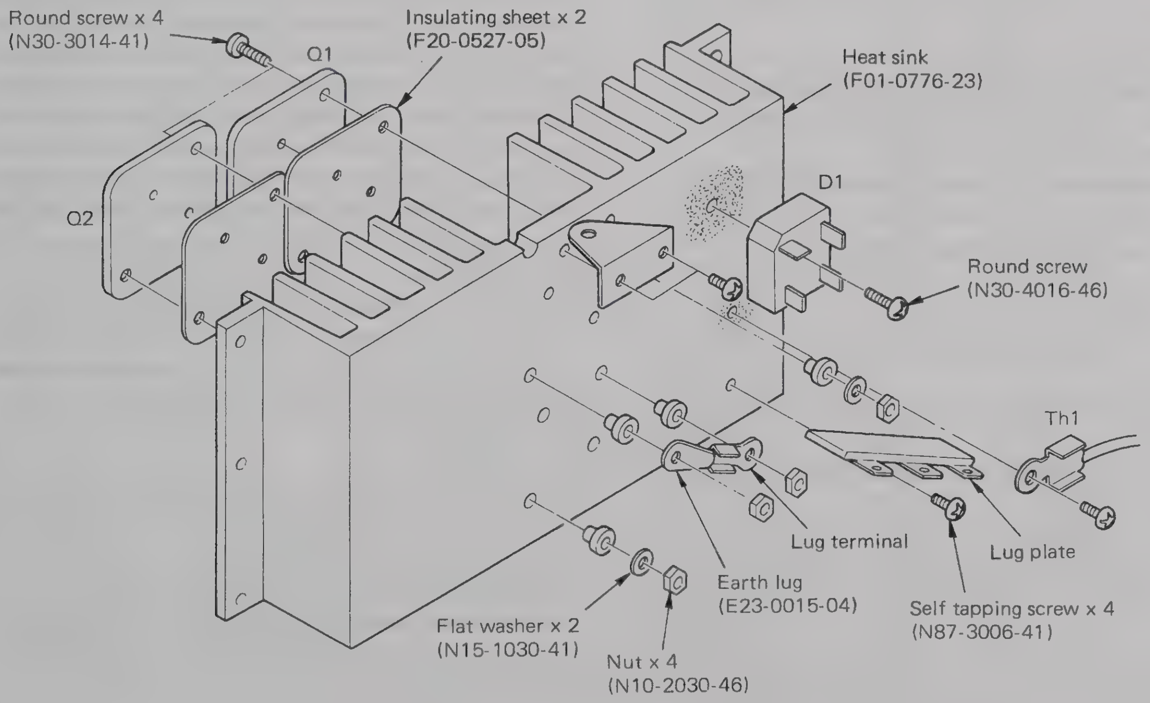

Push switch POWER
(S40-2437-05)
3P phone jack PHONES
(E11-0404-05)
Meter
(B31-0635-04)
Pilot lamp 28V x 2
(B30-0826-05)
Hex. boss x 2
(J32-0827-04)
Round screw x 3
(N30-3004-46)
Mounting hardware C
Meter mounting hardware
Round screw x 2
(N30-3004-46)
Remote switch shaft MODE
(S90-0401-05)
Push knob POWER
(K29-0757-04)
Flat screw x 2
(N32-3006-41)
Cusion A x 2
Main encoder unit
(X54-1680-00)
Self tapping screw x 6
(N87-2608-46)
Flat screw x 2
(N32-3006-41)
Front glass (small)
(B10-0651-04)
RIT encoder unit
(X54-1690-00)
D
I
C
J
E
B
A
O
L
Cushion
Push knob BAND
(K29-0760-04)
M
N
F
Push knob 1MHz STEP UP
(K27-0431-04)
Push knob 1MHz STEP DOWN
(K27-0432-04)
Round screw x 4
(N30-3006-46)
Push knob x 4 VOX/MAN, FULL/SEMI, MONI, DIM/NOR
(K27-0434-04)
Mounting hardware D
Flat screw x 2
(N32-3006-41)
Band escutheon
(B07-0638-04)
Push knob x 4 A=B, VFO/MEMO, MIN, MR
(K27-0433-04)
Mounting hardware A
Push knob x 2 NB1, NB2
(K27-0433-04)
Panel
(A20-2440-12)
Push knob x 6 T-F SET, RIT, CLEAR, NOTCH, AF TUNE, D. LOCK
(K27-0433-04)

SWITCH UNIT (X41-1410-00) A−O

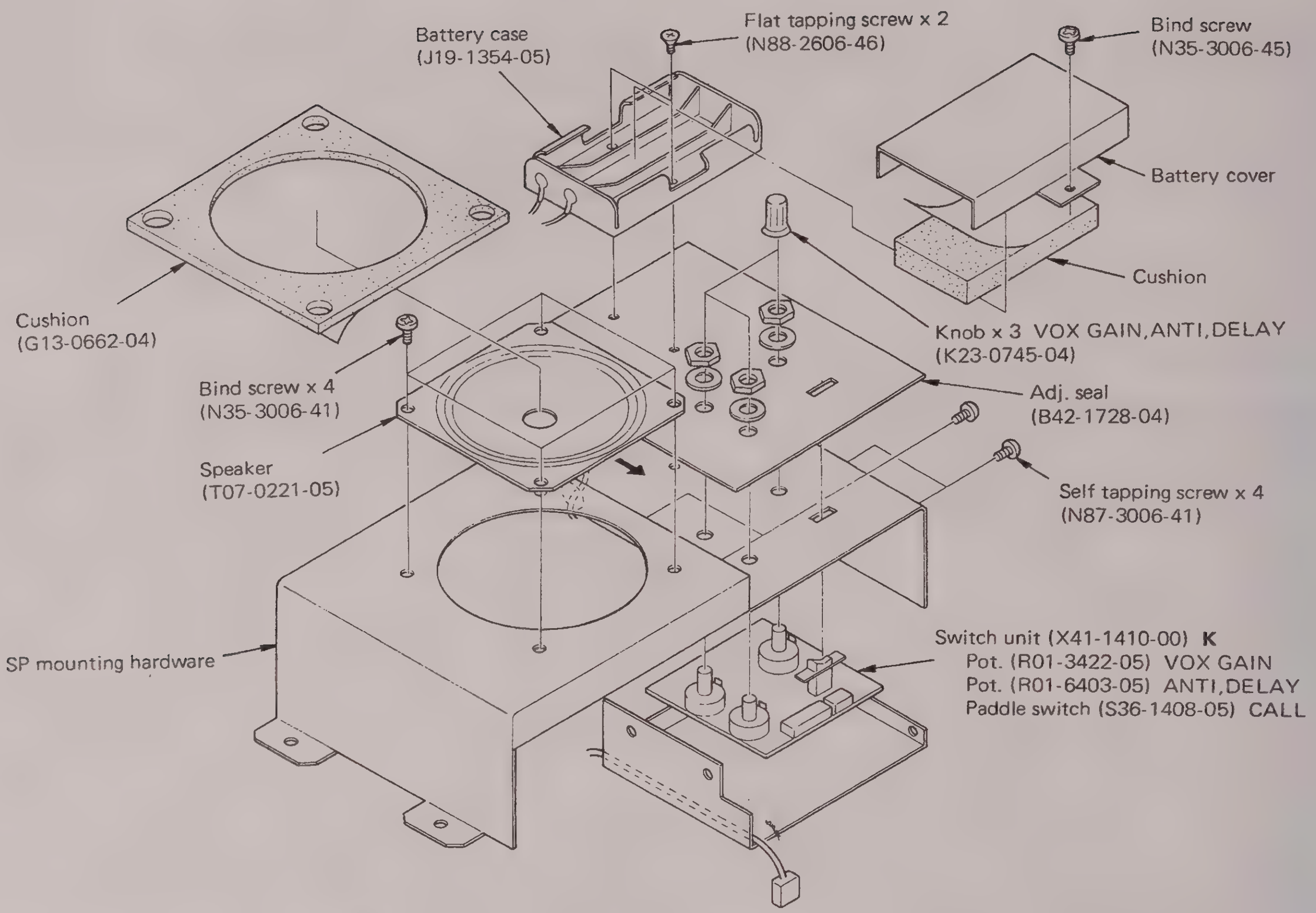
A	VR3	(R19-3414-05)	Pot.	SSB SLOPE TUNE
	VR4	(R24-9402-05)	Pot.	PITCH/AF TUNE
	VR5	(R01-3424-05)	Pot.	CW VBT
	S10	(S90-0402-05)	Slide switch	MODE
B	D3	(V11-7261-16)	BG5532K	ANT TUNE
	D4,5	(V11-7272-36)	PR5532K	ON AIR, NOTCH
C	S6−9	(S36-2408-05)	Paddle switch	STBY, AT, PRO., TONE
D	VR1,2	(R19-9407-05)	Pot.	PROCESSOR, MIC/DAR
E	S39	(S01-1430-05)	Rotary switch	METER
	S40	(S01-1431-05)	Rotary switch	AGC
F	VR6	(R01-3423-05)	Pot.	NOTCH
	VR7	(R19-3413-05)	Pot.	AF/RF
I	S2,5	(S40-2433-05)	Push switch	VOX/MAN, DIM/NOR
	S3,4	(S40-2434-05)	Push switch	FULL/SEMI, MONI
J	−	(E06-0853-05)	8P metal socket	MIC
L	S26,27	(S50-1409-05)	Tact switch	1MHz STEP
	S28−37	(S50-1411-05)	Tact switch	BAND
M	VR8	(R01-0406-05)	Pot.	NB LEVEL
	S17,19,20	(S40-2435-05)	Push switch	A=B, M_{IN}, MR
	S18,21,22	(S40-2434-05)	Push switch	VFO/MEMO, NB1, NB2
	S23,25	(S01-1432-05)	Rotary switch	FUNCTION, RF ATT
	S24	(S01-1429-05)	Rotary switch	M. CH
N	S11,13	(S40-2432-05)	Push switch	T-F SET, RIT-CL
	S12	(S40-2431-05)	Push switch	RIT
	S14,16	(S40-2422-05)	Push switch	NOTCH, D. LOCK
	S15	(S40-2433-05)	Push switch	AF TUNE
O	V1	(V40-7760-66)	11-BT-03Z	Display tube

DISASSEMBLY


3P phone jack KEY
(E11-0404-05)
Phone jack EXT. SP
(E11-0410-05)
Rear panel
(A23-1466-22)
Nut x 3
(N10-2030-46)
4P pin jack
(E13-0461-05)
7P DIN socket REMOTE
(E06-0751-05)
8P DIN socket X. VERTER
(E06-0851-05)
Slide switch RX ANT
(S31-1407-05)
Fuse holder
(J13-0033-15)
Bind screw x 3
(N35-3006-45)
Fuse 4A (F05-4022-05) M,T,W,X
Fuse 6A (F05-6021-05) K
3P inlet AC power
(E18-0351-05)
Round flat screw x 2
(N33-3006-45)
Round screw x 4
(N30-2606-45)
Round screw x 2
(N30-2004-41)
1P pin jack RX ANT
(E13-0101-05)
Wing nut
(N14-0509-05)
Flange nut
(N14-0115-05)
Flat washer x 3
(N15-1040-41)
Switch unit (X41-1410-00) H
UHF type receptacle (E04-0152-05) ANT


Round screw x 4
(N30-3014-41)
Insulating sheet x 2
(F20-0527-05)
Q1
Heat sink
(F01-0776-23)
Q2
D1
Round screw
(N30-4016-46)
Th1
Lug terminal
Lug plate
Earth lug
(E23-0015-04)
Self tapping screw x 4
(N87-3006-41)
Flat washer x 2
(N15-1030-41)
Nut x 4
(N10-2030-46)

DISASSEMBLY


Battery case
(J19-1354-05)
Flat tapping screw x 2
(N88-2606-46)
Bind screw
(N35-3006-45)
Battery cover
Cushion
Cushion
(G13-0662-04)
Knob x 3 VOX GAIN, ANTI, DELAY
(K23-0745-04)
Bind screw x 4
(N35-3006-41)
Adj. seal
(B42-1728-04)
Speaker
(T07-0221-05)
Self tapping screw x 4
(N87-3006-41)
SP mounting hardware
Switch unit (X41-1410-00) K
Pot. (R01-3422-05) VOX GAIN
Pot. (R01-6403-05) ANTI, DELAY
Paddle switch (S36-1408-05) CALL

● Disassembly and cautions for rear panel

(1) Take care not to damage terminals ANT and GND on the rear panel since they are soldered or screwed to the PC board.

(2) When repairing the final section, remove the upper and lower cases, then the final heatsink and shield case for the Filter unit. (When repairing the Filter unit, remove the above parts, too.)

● Disassembly and cautions for internal mechanism

(1) Cautions on replacement of transformer
Tighten the hexagon socket head bolts to a torque of 20kg-cm. Check the transformer for shock, looseness, and correspondence.

(2) When repairing the Signal unit under the chassis, take much care.
1) To remove the PC board from the chassis, remove 19 screws.
2) The weight of PC board and radiator plate is about 1kg in total.
However, the optional filter can be installed easily without removing the Signal PC board.

(3) Removing mounting hardware for the electrolytic capacitor
The mounting hardware for electric capacitor can be removed by removing two screws from one side of the mounting hardware and sliding it toward the screws (to left side when viewed from the front panel).

(4) The speaker is installed to the mounting hardware on the chassis, different from the models in the past.

● Disassembly for front panel

(1) The front panel may be tilted for servicing by removing the 2 flat head screws at the top sides of the panel, and loosening the 2 round head screws at the bottom. Use caution as the panel is heavy and may fall forward.

(2) When replacing the name plate on the display window for display tube and meter, 1st remove the meter. Push the name plate from rear with a thin screw driver through the square hole on the panel. When replacing the front glass, remove the name plate and two flat screws (M2 x 6). (The front glass grille can be removed at the same time.)

(3) When removing the display tube from the mounting bracket, insert a thin screw driver, etc. into the bracket at both sides. Remove the display tube with the screw driver form the projection of the mounting hardware for display tube.

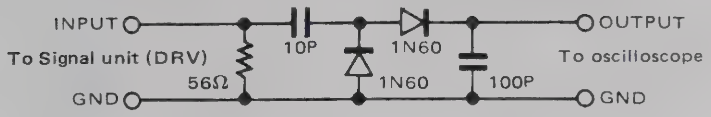
(4) Removing main knob
Slip the outside rubber ring from the knob. The allen set screw can now be loosened and the knob removed.

(5) Removing band switch assembly
Remove the six screws securing the PC board. Then, remove push knobs (1.5 3.5 ......), cushions, and the four round screws which secure the escutcheon to the front panel.

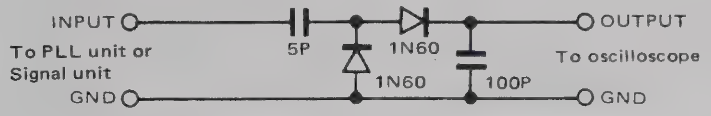
ADJUSTMENT

REQUIRED TEST EQUIPMENT

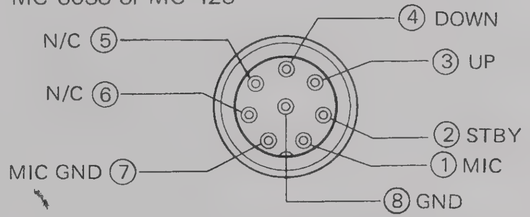
1. DC Voltmeter (DC V.M)
   1) Input resistance : More than 1 MΩ
   2) Voltage range : 1.5 to 1000 V AC/DC
   NOTE : A high-precision multimeter may be used. However, accurate readings can not be obtained for high-impedance circuits.
2. DC Ammeter
   1) Current range : 100 mA, 1.5 A, 15 A, High-precision ammeter may be used.
3. RF VTVM (RF V.M)
   1) Input impedance : 1 MΩ and less than 3pF, min.
   2) Voltage range : 10 mV to 300 V
   3) Frequency range : 10 kHz to 100 MHz or greater
4. AF Voltmeter (AF V.M)
   1) Frequency range : 50 Hz to 10 kHz
   2) Input resistance : 1 MΩ or greater
   3) Voltage range : 10 mV to 30 V
5. AF Generator (AG)
   1) Frequency range : 200 Hz to 5 kHz
   2) Output : 1 mV or less to 1 V, low distortion
6. AF Dummy Load
   1) Impedance : 8Ω
   2) Dissipation : 3W or greater
7. Oscilloscope (Dual trace)
   Requires high sensitivity, and external synchronization capability.
8. Sweep Generator
   1) Center frequency : 50 kHz to 90 MHz
   2) Frequency deviation : Maximum ±35 MHz
   3) Output voltage : 0.1 V or greater
   4) Sweep rate : At least 0.5 sec/cm
9. Standard Signal Generator (SSG)
   1) Frequency range : 50 kHz to 50 MHz
   2) Output : −20 dB/0.1μV to 120 dB/1 V
   3) Output impedance : 50Ω
   4) AM and FM modulation can be possible.
   NOTE : Generator must be frequency stable.
10. Frequency Counter (f. counter)
    1) Minimum input voltage : 50 mV
    2) Frequency range : 50 MHz or greater
    3)
11. Noise Generator
    Must generate ignition-like noise containing harmonics beyond 30 MHz.
12. RF Dummy Load
    1) Impedance : 150Ω
    2) Dissipation : 150 W or greater
13. Power Meter
    1) Impedance : 50Ω
    2) Dissipation : 150 W continuous or greater
    3) Frequency limit : 60MHz or greater
14. Spectrum Analyzer
    1) Frequency range : 100 kHz to 110 MHz or greater
    2) Bandwidth : 1 kHz to 3 MHz
15. Detector
    1) For adjustment of TX BPF



    2) For adjustment of PLL/VCO BPF



16. Directional Coupler
17. Monitor Receiver
    R-1000 class
18. Microphone
    MC-60S8 or MC-42S



MIC terminals (View from front panel side)

PREPARATION

Unless otherwise specified, set the controls as follows.

Front panel

POWER	ON	RIT SW	OFF
BAND	14	NB1	OFF
AF	MIN	NB2	OFF
RF	MAX	D. LOCK	OFF
MIC	MIN	AF TUNE	OFF
PROCESSOR IN	MIN	VFO/MEMO.	VFO
PROCESSOR OUT	MIN	MONI	OFF
CAR	MIN	DIM/NOR	NOR
FUNCTION	A	SEND/REC	REC
CW VBT	NORM.	FULL/SEMI	SEMI
SSB SLOPE		MODE	USB
TUNE LOW	MIN	NOTCH SW	OFF
SSB SLOPE		VOX/MAN.	MAN
TUNE HIGH	MAX	AUTO/THRU	THRU
PITCH	CEN	PROCESSOR SW	OFF
AF TONE	CEN	NAR/WIDE	WIDE
NOTCH	CEN	AGC SW	FAST
MEMORY CH.	1	RF ATT	0
METER SW	POWER	NB LEVEL	MIN

Rear panel

RX ANT . . . . .OFF

ADJUSTMENT

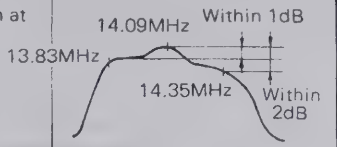
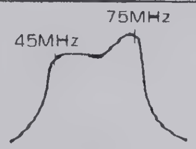
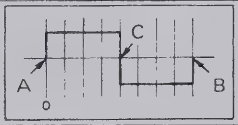
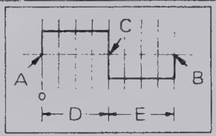
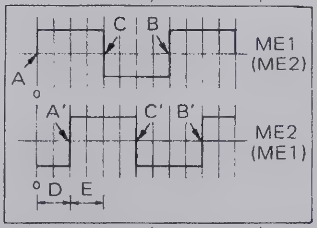
OLTAGE ADJUSTMENT

Item	Condition	Measurement			Adjustment			Specification/Remarks
		Test equipment	Unit	Terminal	Unit	Part	Method	
1.Voltage	1) POWER : ON RF GAIN : MAX (Full CW)	DC V.M	AVR	28B	AVR	VR1	28.5V	± 0.3V
			SIG-NAL	Connector 28-RV	SIG-NAL	VR24	16.0V	± 0.1V
	MODE : USB			R375 (AGC)		VR29	3.20V	± 0.01V
	STBY : REC			Jumper wire J13		VR25	2.20V	± 0.01V
2.TX Control voltage	1) STBY : REC	DC V.M	SIG-NAL	Connector 5-TV			Check	Less than –0.8V
	2) STBY : SEND						Check	16.0V ± 0.3V
	3) STBY : SEND			Jumper wire J89	SIG-NAL	VR13	3.20V	± 0.01V
3. SWR standard voltage	1) STBY : REC	DC V.M	SIG-NAL	IC4-12	SIG-NAL	VR15	0.5V	± 0.01V This is a reference level for the SWR circuitry. It will effect the auto antenna tuner.

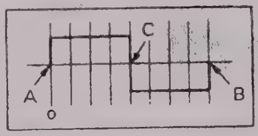
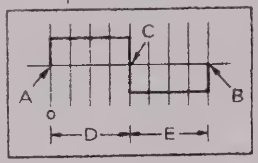
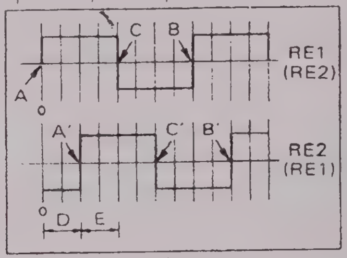
LL ADJUSTMENT

Item	Condition	Measurement			Adjustment			Specification/Remarks
		Test equipment	Unit	Terminal	Unit	Part	Method	
1. Standard Oscillator		f. counter	PLL	IC16-1	PLL	TC1	10,000,000Hz	± 5Hz
2. 40MHz multiplier		RF V.M	PLL	IC14-5	PLL	T16–18	MAX	
3. VCO-3	1)	f. counter	PLL	IC13–15	PLL	TC2	10,240,000Hz	± 10Hz
	2) FREQ : □□.□□1.9$\boxed{9}$kHz To obtain this frequency 1st set dial to □2.0$\boxed{0}$. Then using mic pushbutton depress button (DWN) one step at a time until the display just changes to □1.9$\boxed{9}$ frequency changes in 10Hz steps are obtained in this manner.	DC V.M		Q32-C		T14	4.2V	± 0.05V □ DENOTES STEP 9 (90Hz) or one step before the next 100Hz (.xxx.1) Transition
	3) FREQ : □□.□□0.0$\boxed{0}$kHz Use similar method in step 3. 2) PLL adjustment						Check	9.5V ± 0.5V
4. VCO-2	1) FREQ : □□,999.9$\boxed{9}$kHz Use similar method in step 3. 2) PLL adjustment.	DC V.M	PLL	Q24-C	PLL	T15	3.5V	± 0.05V
	2) FREQ : □□,000.0$\boxed{0}$kHz For 10Hz level, tune VFO one step before □□,999.□□						Check	8.5V ± 0.5V
5. VCO-1L (Low)	1) FREQ : 100.0kHz Tune VFO fully CCW	DC V.M	SIG-NAL	R81	SIG-NAL	L54	13.50V	± 0.1V
	2) FREQ : 9,499.9$\boxed{9}$kHz						Check	6.0V ± 1.0V
6. VCO-1M (Medium)	1) FREQ : 9,500.0$\boxed{0}$kHz For 10Hz level, tune VFO to one step before 9,499.9$\boxed{9}$	DC V.M	SIG-NAL	R81	SIG-NAL	L53	3.00V	± 0.1V
	2) FREQ : 19,499.9$\boxed{9}$kHz						Check	12.0V ± 1.0V
7. VCO-1H (High)	1) FREQ : 29,999.9$\boxed{9}$kHz Tune VFO fully CW to 29,999.99$\boxed{9}$ kHz.	DC V.M	SIG-NAL	R81	SIG-NAL	L52	13.00V	± 0.1V
	2) FREQ : 19,500.0$\boxed{0}$kHz						Check	3.0V + 1.0V, –0.5V

ADJUSTMENT

Item	Condition	Measurement			Adjustment			Specification/Remarks
		Test equipment	Unit	Terminal	Unit	Part	Method	
8. PLL-BPF	1) Disconnect connector 8, CAR 1. Reconnect after adjustment.	Sweep generator Detector Oscilloscope	PLL	IC6-2 Q17-E	PLL	T7–9	Adjust as shown at right.	
9. PLL 8.85MHz IF	1)	RF V.M	PLL	IC6-5 or IC7-2	PLL	T13	MAX	(Ref. 100mV–120mV)
	2)					VR1	100mV	± 5mV
10. PLL 5.2MHz IF	1)	RF V.M	PLL	Q17-E	PLL	T10	MAX	
	2)			IC6-2		VR2	100mV	± 5mV
11. PLL 50.15MHz IF	1)	RF V.M	PLL	Q18-E	PLL	TC3	110mV	± 5mV
	2)			Q16-E		T4–6	MAX	(Ref. 100mV)
12. PLL 60.15MHz IF	1)	RF V.M	PLL	IC3-5	PLL	T1–3	MAX	
	2)					T11,12	MAX	
	3)			Q17-E			Check If above 150mV, lower to below 150 mV with VR1. (Must remove VCO shield).	100–150mV
13. VCO-BPF		Sweep generator Detector Oscilloscope	SIGNAL	Q16-G Q20-E	SIGNAL	L66–68	Adjust as shown at right.	
14. 36.1MHz HET	1)	RF V.M	SIGNAL	R125	SIGNAL	L77	0.21V (Adjust CW from MAX in direction [core is inserted].)	0.5dB
	2)	f.counter					Check	36.100MHz ± 1kHz
15. VCO level	1) FREQ : 15,250.0kHz	RF V.M	PLL	Q14-E	PLL	TC4	160mV	± 10%
16. Main encoder	1) Remove the VFO knob and motor-drive the encoder at approx 300 rpm.	Oscilloscope	Digital	Connector 4-ME1				Point C may be located anywhere. When a motor is not available, manually turn the VFO to check the duty ratio. (AC=CB)
	2) ME1 duty ratio adjustment : Turn motor CW and CCW				Main encoder	VR1		After adjusting with the VFO control turned CW, check that intervals D and E are also identical when the VFO control is turned CCW.
	3) ME2 duty ratio adjustment : (Check as for ME1)			Connector 4-ME2		VR2	Adjust until intervals D and E are equal to each other with point C placed at the center.	
	4) ME1, ME2 phase difference alignement  C B ME1 (ME2) A o A' C' B' ME2 (ME1) o D E			Connector 4-ME1 and ME2		Phase adjustment screw	Adjust until intervals D and E are equal to each other (point A' on ME2 is located in the middle of points A and C on ME1 90° phase shift)	ME1 (ME2) : Within 90° ± 10% (The difference between CW and CCW rotation must also be within this specification.) Either ME1 or ME2 may lead, the important point is phase difference.

ADJUSTMENT

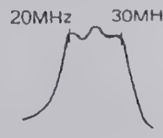
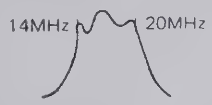
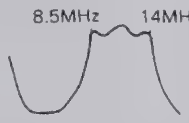
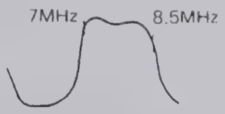
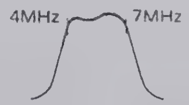
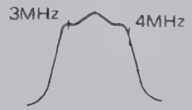
Item	Condition	Measurement			Adjustment			Specification/Remarks
		Test equipment	Unit	Terminal	Unit	Part	Method	
17. RIT encoder	1) Remove the RIT knob and motor-drive the encoder at approx 300 rpm.	Oscillo-scope	Digital	Connector 5-RE1				Point C may be located anywhere. When a motor is not available, manually turn the RIT to check the duty ratio. (AC=CB)
	2) RE1 duty ratio adjustment : Turn a CW and CCW				RIT encoder	VR1		After adjusting with the RIT control turned CW, check that intervals D and E are also identical when the RIT control is turned CCW.
	3) RE2 duty ratio adjustment : Turn motor in both directions.			Connector 5-RE2		VR2	Adjust until intervals D and E are equal to each other with point C placed at the center.	
	4) RE1, RE2 phase difference alignment : Same as above.			Connector 5-RE1 and RE2			 C B RE1 (RE2) A o A' C' B' RE2 (RE1) o D E	Either RE1 or RE2 may lead, the important point is the phase difference. It should be 90°±10% .

o : From S/N 208XXXX–309XXXX
● : From S/N 310XXXX–

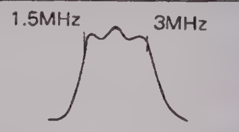
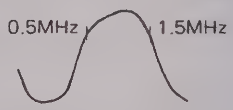
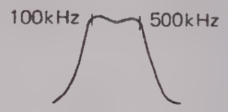
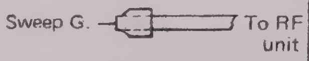
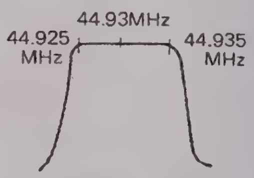
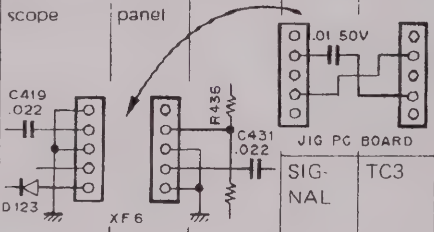
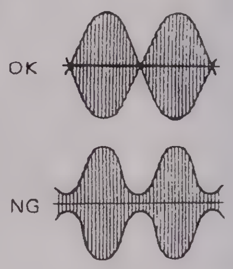
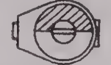
RX ADJUSTMENT

Item	Condition	Measurement			Adjustment			Specification/Remarks
		Test equipment	Unit	Terminal	Unit	Part	Method	
1. CAR-1	1) MODE : USB STBY : REC	RF V.M	SIGNAL	Connector 24-CAR1	SIGNAL	L161	0.21V : o, 0.1V : ● (Adjust CCW from MAX)	± 1dB
	2) STBY : REC ↔ SEND	f.counter				VR27	No change in frequency when switched from TX to RX.	
	3) STBY : REC					TC4	8831.5kHz	These are preliminary adjustments. Do not forget to perform the transmitter frequency response portion steps 15, 1) through 6).
	4) MODE : LSB STBY : REC					TC5	8828.5kHz	
	5) MODE : FSK STBY : SEND					VR26	8827.79kHz	
	6) MODE : CW NAR/WIDE : NARROW STBY : SEND					TC6	8830.000kHz	± 10Hz

ADJUSTMENT

Item	Condition	Measurement			Adjustment			Specification/Remarks
		Test equipment	Unit	Terminal	Unit	Part	Method	
2. CAR-2 If TC3 is adjusted, Step 8 adjustments must be performed.	1) MODE : USB STBY : REC	RF V.M	SIGNAL	Q79-E (R472)	SIGNAL	L142–145	MAX	
						L139	0.35V (Adjust CCW from MAX)	± 1dB
	2) MODE : USB ↔ LSB STBY : REC					L144, 145	Same level, When switched from USB to LSB.	± 0.5dB
	3) MODE : USB STBY : REC ↔ SEND	f. counter		C298		VR23	No change in frequency, when switched from TX to RX.	
	4) MODE : USB STBY : REC					TC3	8.375MHz	
3. CAR-3	1) MODE : CW STBY : REC	f. counter	SIGNAL	Q141-E	SIGNAL	L169	100,000Hz (100kHz)	± 20Hz
	2) MODE : USB						Verify	101.5kHz ± 200Hz
	3) MODE : LSB							98.5kHz ± 200Hz
	4) MODE : AM							100.0kHz ± 100Hz
	5) MODE : FSK							98.5kHz ± 200Hz
	6) MODE : TUNE							100.0kHz ± 20Hz
4. CW PITCH Rotate RF gain full CCW this step only.	1) MODE : CW CW PITCH : 12 o'clock STBY : REC	RF V.M	SIGNAL	R836	SIGNAL	L172	MAX	0.27–0.47V (reference)
		f. counter				L173	99,200Hz	± 20Hz
5. 355kHz BPF	1) MODE : CW STBY : REC	RF V.M	SIGNAL	Q129-G2	SIGNAL	L146–148	MAX	0.4V ± 0.1V (reference)
6. 0.1–30MHz BPF (Step 11 must also be performed).	1) BAND : 20.0–30.0MHz FREQ : 29,500.0kHz RF ATT : 0dB STBY : REC Disconnect SIGNAL unit, FRO connector, and connect this plug to detector.	Sweep generator Detector Oscilloscope	Body RF	ANT RIF	SIGNAL	L43–45	Adjust as shown at right.	
	2) BAND : 14.0–20.0MHz FREQ : 18,000.0kHz					L40–42		
	3) BAND : 8.5–14.0MHz FREQ : 10,000.0kHz					L38–39		
	4) BAND : 7.0–8.5MHz FREQ : 7,000.0kHz					L33–35		
	5) BAND : 4.0–7.0MHz FREQ : 6,900.0kHz					L29–32		
	6) BAND : 3.0–4.0MHz FREQ : 3,900.0kHz					L25–27		

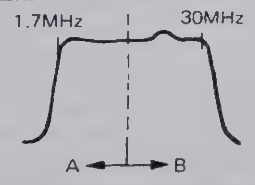
ADJUSTMENT

Item	Condition	Measurement			Adjustment			Specification/Remarks
		Test equipment	Unit	Terminal	Unit	Part	Method	
	7) BAND : 1.5–3.0MHz FREQ : 1,900.0kHz	Sweep generator Detector Oscillo-scope	Body RF	ANT RIF	SIG-NAL	L22–24	Adjust as shown at right.	
	8) BAND : 0.5–1.5MHz FREQ : 1,000.0kHz					L18,19		
	9) BAND : 100–500kHz DISPLAY : 300.0kHz					L15–17		
7. 44.93MHz MCF	1) STBY : REC Disconnect SIGNAL unit, VCOF connector, and connect plug to Sweep GEN.  Detector must be grounded near R336. Reconnect VCOF connector after adjustment.	Sweep generator Detector Oscillo-scope	RF SIG-NAL	VCOF R336	SIG-NAL	L121–124	1) Crest value : MAX 2) Ripple : MIN Adjust as shown at right.	 44.93MHz ± 5kHz
3. SSB SLOPE TUNE	1) MODE : CW SSB SLOPE TUNE HIGH CUT CONTROL : MAX (Full CW) LOW CUT CONTROL : MIN (Full CCW) Disconnect XF-6 2P connector and insert set-up jig PC board. NAR-WIDE SW : NAR	VBT-1 Oscillo-scope  .01 50V JIG PC BOARD C419 .022 D123 XF6 R436 C431 .022	SIG-NAL Rear panel	Connec-tor 7-1P IF OUT			Adjust VBT-1 f VR to obtain waveform shown at right.	
	2) NAR-WIDE SW : WIDE Remove jig PC board from XF-6 and reinstall 2P connector.				SIG-NAL	TC3	Adjust as shown at right.	
). RX IF-AMP Steps 10,12 nust also be performed).	1) FREQ : 14,175.0kHz MODE : USB RF GAIN : CW MAX AGC : OFF SSG output : 14.175MHz	SSG AF V.M Oscillo-scope AF dummy load	Rear panel	ANT EXT.SP	RF SIG-NAL	T3–5, TC1 L125–132, 146–148, 165–168.	MAX (AF output) Rotate L126 core out by 30° from peak. T4 : 2.5 turns down from flush then TC1 mechani-cal center. Then T3 for MAX	S/N : better than 10dB/0.63V (8Ω) with (−6dB) SSG output.  TC1 Mechanical center Note: TC1 ; From S/N 208XXXX–309XXXX
	2) Disconnect SSG	RF VTVM	RF	RIF	RF	VR1	MIN	Note: VR1; from S/N310XXXX–
10. NOTCH If Step 9 ad-ustments are performed, these idjustments nust also be performed).	1) FREQ : 14,175.0kHz MODE : USB NOTCH CONTROL : 1 o'clock SSG output : 14.175MHz 0dB/μ	SSG AF V.M Oscillo-scope AF dummy load f. counter	Rear panel	ANT EXT.SP			Adjust for 1500Hz/0.63V AF output.	
	2) NOTCH SW : ON SSG output : 40dB/μ				SIG-NAL	L167 VR28	MIN Adjust while slowly raising SSG output.	
	3) Adjust NOTCH control to verify operating point turn NOTCH SW off after checking.							Dip point must occur between 12 : 30 and 1 : 30.

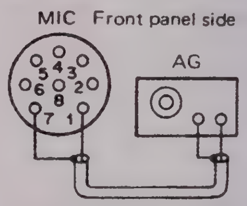
ADJUSTMENT

Item	Condition	Measurement			Adjustment			Specification/Remarks
		Test equipment	Unit	Terminal	Unit	Part	Method	
11. IF trap (If Step 6-1 adjustment is perfomed, this adjustment must also be performed).	1) BAND : 28 MODE : USB SSG output : 44.93MHz 80dB/μ	SSG	Rear panel	ANT	SIGNAL RF	L11,12 T7	MIN	Almost all received waveform must disappear.
12. S meter (If TC1 is adjusted in step 9 perform this adjustment).	1) AGC : OFF METER SW : POWER	S meter			SIGNAL	VR30	Set to S meter starting point.	
	2) FREQ : 14,175.0kHz AGC : FAST SSG output : 14.175MHz 0dB/μ	SSG S meter AF V.M Oscilloscope AF dummy load	Rear panel	ANT EXT.SP		VR1	Adjust CCW to the point where AF V.M reading decreases by 0.5dB.	
	3) SSG output : 8dB/μ					TC1	S1	8dB ± 4dB
	4) SSG output : 40dB/μ					VR31	S9	40dB ± 6dB
	5) SSG output : 100dB/μ						SSG output : 100dB Repeat step 1) through 4) if necessary.	S9 + 60dB ± 6dB Check
13. NB	1) FREQ : 14,175.0kHz MODE : USB SSG output : 14,175.0kHz	SSG DC V.M	Rear panel SIGNAL	ANT R144	SIGNAL	L80,81	1) MIN (SSG output : 20dB) Lower SSG output to the point where DC voltage falls slightly, and again reset to MIN.	
	2) MODE : USB NB LEVEL : CCW	Moise GEN. S meter	Rear panel	ANT			Adjust Noise GEN. level to read to S1.	
	3) NB 1 SW : ON Adjust NB LEVEL control to the point where N.B. action begins. (After checking, turn NB 1 SW : OFF)				SIGNAL	L80,81	MIN (If NB level has insufficient effect, adjust L126 core slightly CCW (out) from peak.	Noise disappears.
	4) NB 2 SW : ON (After checking, shut NB 2 SW OFF)						Check	The same effect as NB 1 is obtained.
	5) Raise Noise GEN. level to S9. NB 1 SW : ON (After checking, turn NB 1 SW OFF).						If any noise remains adjust NB LEVEL to find the point where NB operates.	Noise disappears.
14. Microprocessor Audio-Tone indicator	1) AF GAIN : MIN CLEAR SW : Push	AF V.M Oscilloscope AF dummy load	Rear panel	EXT.SP	SIGNAL	VR33	50mV/8Ω	± 3dB

TX ADJUSTMENT

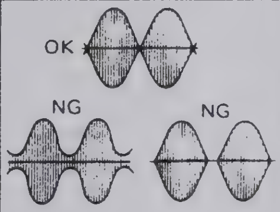
Item	Condition	Measurement			Adjustment			Specification/Remarks
		Test equipment	Unit	Terminal	Unit	Part	Method	
1. TX-BPF	1) FREQ : 14,175.0kHz STBY : SEND Disconnect DRV connector and terminate with a 50Ω dummy load. (After adjustment, remove and reconnect DRV connector).	Sweep generator Detector Oscilloscope	SIGNAL	R196 DRV	SIGNAL	L92–88, L84	Adjust in order, L92–88,84 so that waveform shown at right is obtained when crest value is MAX. (Adjust sweep band A and B separately).	

ADJUSTMENT

Item	Condition	Measurement			Adjustment			Specification/Remarks
		Test equipment	Unit	Terminal	Unit	Part	Method	
2. Drive	1) FREQ : 14,175.0kHz MODE : CW Disconnect DRV connector and terminate with a 50Ω dummy load. Adjust CAR control for DRV terminal voltage is less than 1.5V. STBY : SEND	RF V.M	SIG-NAL	DRV	SIG-NAL	L94–99, 111, 112, 115, 132	MAX 1) Adjust in order; L115, 112–94 and 132. 2) Repeat in order; L99, 111, and 94–97.	
3. TX IF-AMP	1) FREQ : 14,175.0kHz MODE : USB Disconnect DRV connector and terminate with a 50Ω dummy load. Adjust MIC control so voltage at DRV terminal is 1.0V ± 0.5V. AG output : 1500Hz, 2mV STBY : SEND	RF V.M AG	SIG-NAL Front panel	DRV MIC	SIG-NAL	L152, 153, 134, 133, 112	MAX 1) Adjust in order ; L152,153,134,133 and 112. 2) Repeat in order ; L152 and 153.	 MIC Front panel side AG 1 2 3 4 5 6 7 8
4. IC METER φ point	1) METER SW : IC Disconnect connector in the FINAL unit, 28V line. STBY : SEND (After adjustment, reconnect this connector).	S meter			SIG-NAL	VR18	IC meter reads φ (start) point.	
5. 100W FINAL IAS	1) FREQ : 14,175.0kHz MODE : USB MIC CONTROL : MIN Desolder L7 lead and connect ammeter in its place, minus to L7 side STBY : SEND (After adjustment, resolder L7 lead.)	DC am-meter	FINAL	L7	FINAL	VR2	70mA Note: Stabilization requires approximately 20 seconds.	± 10mA
	2) FINAL unit VR1 : MIN Disconnect connector in FINAL unit, 28V line and connect ammeter in its place. STBY : SEND (Disconnect ammeter and reconnect this connector after adjustment.)					VR1	1.3A	1.1–1.5A
6. IC meter	1) FREQ : 14,175.0kHz MODE : CW Disconnect connector in FINAL unit, 28V line (Plus side) and connect ammeter in its place. STBY : SEND (Adjust CAR control to draw 10A current.)	DC am-meter			SIG-NAL	VR17	10A	
	2) Adjust CAR control for 2A current. (Disconnect ammeter and reconnect this connector after adjustment.)						IC meter 2A	± 0.3A Check
7. Current miter is adjustment is performed, Step 8 must also be performed.)	1) FREQ : 14,175.0kHz MODE : CW CAR CONTROL : MAX	DC am-meter	FINAL	28V line connec-tor				
	Adjust SIGNAL unit, VR8 in advance for 10A current. STBY : SEND	DC V.M	SIG-NAL	Q49-B	SIG-NAL	VR10	0.42V	

ADJUSTMENT

○ : From S/N 208XXXX–309XXXX
● : From S/N 310XXXX–

Item	Condition	Measurement			Adjustment			Specification/Remarks
		Test equipment	Unit	Terminal	Unit	Part	Method	
8. Power	1) FREQ : 14,175.0kHz MODE : CW CAR CONTROL : MAX STBY : SEND	Power meter	Rear panel	ANT	SIG-NAL	VR8	110W	Not to exceed 125W
9. Power meter	1) FREQ : 14,175.0kHz MODE : CW STBY : SEND CAR CONTROL : Set for external power meter reading of 100W.	Power meter S meter	Rear panel	ANT	SIG-NAL	VR14	110W	± 5W
10. AM power From S/N 208XXXX–309XXXX	1) FREQ : 28.1MHz MODE : AM MIC CONTROL : MAX STBY : SEND	Power meter	Rear panel	ANT	SIG-NAL	L175 VR22	Adjust for MAX power with L175, then set to 30W with VR22.	± 3W Note : AM power can be adjusted by CAR control at front panel from S/N 310XXXX.
11. Tune power setting	1) FREQ : 14,175.0kHz MODE : TUNE CAR CONTROL : MAX STBY : SEND	Power meter	Rear panel	ANT	SIG-NAL	VR7	55W	
12. Protection	1) FREQ : 14,175.0kHz MODE : CW CAR CONTROL : MAX METER SW : POWER ANT : OPEN STBY : SEND	S meter			SIG-NAL	VR9	10W	± 2.5W
13. SWR meter	1) FREQ : 3,575.0kHz MODE : CW CAR CONTROL : MAX STBY : SEND	150Ω dummy load S meter	Rear panel	ANT	SIG-NAL	VR16	SWR 3	
	2) STBY : SEND	Power meter (50Ω) S meter					Check	SWR 1.2 or less
14. Vc meter	1) FREQ : 14,175.0kHz MODE : USB MIC CONTROL : MIN METER SW : VC STBY : SEND	Power meter S meter	Rear panel	ANT	SIG-NAL	VR19	28.5V (Power voltage)	± 0.5V
15. SSB mode Frequency response	1) FREQ : 14.175,0kHz MODE : USB AG output : 2 tone, 7mV 300Hz, 2700Hz ; ○, 300Hz, 2900Hz ; ● Adjust MIC control for 50W. STBY : SEND	Power meter Oscilloscope AG	Rear panel Front panel	ANT (Directional coupler) MIC	SIG-NAL	TC4	Adjust as shown at right. (Equal 300Hz, 2700Hz ; ○ , 300Hz, 2900Hz ; ● amplitude within 5W).	
	2) MODE : LSB STBY : SEND					TC5		
	3) MODE : USB, LSB AG output : 1500Hz, 5mV STBY : SEND						Calibrate oscilloscope.	
	4) MODE : USB, LSB AG output : 2600Hz, 5mV STBY : SEND						Check	Within 6dB (at 1500Hz).
	5) MODE : USB, LSB AG output : 400Hz, 5mV STBY : SEND							
	6) Check carrier suppression after this adjustment.				SIG-NAL	TC2 VR21	MIN	–40dB or less.

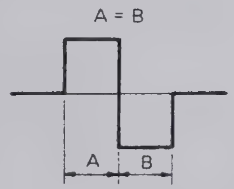
ADJUSTMENT

Item	Condition	Measurement			Adjustment			Specification/Remarks
		Test equipment	Unit	Terminal	Unit	Part	Method	
16. Carrier suppression (If step 15 is performed, this adjustment must also be performed.)	1) FREQ : 14,175.0kHz MODE : USB ↔ LSB MIC CONTROL : MIN STBY : SEND	Oscilloscope (Spectrum analyzer)	Rear panel	ANT (through Directional coupler)	SIGNAL	TC2 VR21	MIN (Adjust alternately.) Adjust for no difference between USB and LSB.	
	2) MODE : CW CAR CONTROL : MAX STBY : SEND						Calibrate Oscilloscope (Spectrum analyzer.)	
	3) MODE : USB ↔ LSB STBY : SEND						Check If less than −40dB, repeat adjustment 1).	−40dB or less
17. ALC meter	1) FREQ : 14,175.0kHz MODE : USB METER SW : ALC MIC CONTROL : MIN AG output : 1500Hz, 5mV STBY : SEND	S meter Power meter AG	Rear panel Front panel	ANT MIC	SIGNAL	VR11	Set to starting point of ALC meter.	
	2) MIC CONTROL : Adjust for ALC meter start point. STBY : SEND							
	3) AG output : 10mV STBY : SEND					VR12	Adjust for maximum ALC zone reading.	
Speech processor	1) FREQ : 14,175.0kHz MODE : USB METER SW : COMP PROC SW : ON AG output : 1500Hz, 1mV PROCESSOR OUT CONTROL : MIN MIC CONTROL : MIN STBY : SEND Adjust meter with PROCESSOR IN Control.	S meter Power meter AG	Rear panel Front panel	ANT MIC	SIGNAL	L136	Adjust for maximum COMP meter reading.	
	2) PROCESSOR IN CONTROL: Set to COMP meter starting point. STBY : SEND							
	3) AG output : + 20dB (10mV) STBY : SEND					VR20	Adjust for 20dB COMP meter.	
	4) METER SW : ALC STBY : SEND PROCESSOR IN CONTROL: ALC zone maximum.					L135	Adjust for maximum ALC zone reading.	
19. Monitor level	1) FREQ : 14,200.0kHz MODE : USB CAL SW : ON	AF V.M Oscilloscope AF dummy load	Rear panel	EXT. SP			Receive marker, and adjust AF gain for 0.63V/8Ω output.	
	2) METER SW : ALC MONI SW : ON AG output : 1kHz, 10mV MIC CONTROL : within ALC zone. AGC : FAST STBY : SEND	Power meter AG	Rear panel Front panel	ANT MIC	SIGNAL	L113 VR34	1) L113 : Monitor output maximum. 2) VR32 : 0.63V/8Ω.	± 3dB

ADJUSTMENT

Item	Condition	Measurement			Adjustment			Specification/Remarks
		Test equipment	Unit	Terminal	Unit	Part	Method	
	3) MIC VR : MIN Remove AG from MIC terminal STBY : SEND						Check hum and noise.	1.5mV/8Ω or less
20. MIX balance	1) FREQ : 21,100.0kHz MODE : AM MIC CONTROL : MIN STBY : SEND	Power meter Monitor receiver (Spectrum analyzer)	Rear panel	ANT	SIG-NAL	VR6	21.555MHz : MIN (S meter and AF output.)	
	2) MODE : CW					VR3	21.900MHz : MIN (S meter and AF output.)	
	STBY : SEND					VR2	23.850MHz : MIN (S meter and AF output.)	
21. Side tone	1) MODE : CW AF GAIN : 12 O'clock PITCH CONTROL : 12 O'clock MONI SW : ON	AF V.M Oscilloscope f. counter	Rear panel	EXT. SP	SIG-NAL	VR32	0.63V/8Ω 800Hz	± 100Hz
	2) PITCH CONTROL : MIN ↔ MAX						Check	800Hz ± 300Hz or more

ANTENNA TUNER

Item	Condition	Measurement			Adjustment			Specification/Remarks
		Test equipment	Unit	Terminal	Unit	Part	Method	
AT-930 Auto antenna tuner (If installed)	1) FREQ : 29,700.0kHz MODE : TUNE CAR VR : MAX METER : SWR STBY : SEND Adjust VR1 so that the motors do not stop at all.	150Ω RF dummy load	Rear panel	ANT	AT	TC1	Adjust TC1 to minimize the angle of motor rotation between points at which the motors are alternately reversed.	
	2) FREQ : 3,500.0kHz First tune, then REC							
	Disconnect the ④ connector. STBY : SEND Turn VFO frequency (up) untill SWR becomes "2".	Oscilloscope	AT	J12	AT	VR2	Adjust as shown at right.	
	3) STBY : SEND Turn VFO frequency (down) untill SWR becomes "1.15" After adjustment. STBY : REC Reconnect the ④ connector.					VR1	Adjust VR1 until ANT TUN indicator just goes off.	
	4) FREQ : Check at the following frequencies.						Check	SWR 1.2 or less.

Order	Frequency
1	1,900.0kHz
2	3,750.0
3	7,150.0
4	14,175.0
5	21,225.0
6	28,800.0

ADJUSTMENT

MICROPROCESSOR OPERATION CHECK

Item	Condition	Operation check
1. Reset	1) Turn POWER SW off and (If installed remove backup batteries, then ground IC13 (μPD5101LC) pin 22 on Digital unit to reset. If backup batteries are not installed, and POWER SW has been off 24 hours or more, reset is complete. (In all other cases, functions set before POWER SW was turned off are backed up. FUNCTION SW : A POWER SW : ON	FREQ : 14,000.0kHz 20kHz display : 0kHz VFO-A is displayed.
	2) FUNCTION SW : B Same as 1).	FREQ : 14,000.0kHz VFO-B is displayed.
	3) VFO/MEMO SW : MEMO M.CH SW : 1–8 Same as 1).	FREQ ; 14,000.0kHz MEMO is displayed.
	4) FUNCTION SW : A VFO/MEMO SW : VFO	
2. BAND	1) BAND SW : 1MHz Depress STEP UP once.	15.000.0 is displayed and tone sounds. (sounds continuously if SW is continuously depressed.)
	Then, depress repeatedly	□□, MHz display advances in 1MHz steps and stops at 29. Tone sounds at each step.
	2) BAND SW : 1MHz Depress STEP DOWN once.	28.000.0 is displayed and tone sounds.
	Then, depress repeatedly.	□□, MHz display decreases in 1MHz steps and stops at □□,100.0. tone sounds at each step.
	3) BAND SW : 1.5 → 3.5 → 7 → 10 → 14 → 18 → 21 → 24.5 → 28 → 29 → 21 → 28 → 14 Depress each of the amateur band switches in the order as shown at the right. Insure that display is as shown in the table.	

SW	FREQ. Display	20kHz Analog Display
1.5	1,600.0	600
3.5	3,600.0	600
7	7,100.0	100
10	10,100.0	100
14	14,100.0	100
18	18,100.0	100
21	21,100.0	100
24.5	24,600.0	600
28	28,600.0	600
29	29,600.0	600
21	21,100.0	100
28	28,100.0	100
14	14,100.0	100

Item	Condition	Operation check
3. Dial step	1) FREQ. (Display) : 150kHz Confirm that the display does not change when the VFO is turned counterclockwise. Turn VFO slowly clockwise.	VFO Scale 1 division : 500Hz 1 turn : 10kHz When VFO is advanced two turns, the 20kHz scale advances one step.
	2) Turn VFO knob at a speed of 5–6 turns/sec. (or faster.)	Confirm that the step speed of both the display and analog scale (Rate of change) increases.
	3) Repeat test for counterclockwise rotation.	Confirm alternate tuning direction operation.
4. RIT	1) RIT SW : ON	RIT ON is displayed and tone sounds. (Tone is continuous while SW is depressed.)
	2) FREQ : □□,□10.0kHz RIT SW : ON RIT CONTROL : Clockwise Counterclockwise	Display indicates: 1) Upper limit VFO : □□.□20.0kHz RIT : 9.9kHz 2) Lower limit VFO : □□.□00.0kHz RIT : –9.9kHz
	3) RIT SW : ON/OFF RIT FREQ : 9.9kHz	RIT : ON (Tone sounds.) VFO : □□.□20.0kHz RIT ; 9.9kHz RIT : OFF (Tone sounds.) VFO : □□.□10.0kHz RIT : 9.9kHz
	4) RIT SW : ON RIT FREQ : + 9.9kHz RIT CLEAR SW : ON	VFO : □□.□10.0kHz RIT : 0.0kHz (Tone sounds.)
	5) RIT SW : OFF	RIT ON display goes off and tone sounds.
5. Memory write	1) FREQ : 1,900.0kHz M.CH SW : 1 MIN SW : ON	When MIN SW is depressed, tone sounds. (If continuously depressed tone sounds continuously.)
	2) FREQ : 3,575.0kHz M.CH SW : 2 MIN SW : ON	
	3) FREQ : 7,150.0kHz M.CH SW : 3 MIN SW : ON	
	4) FREQ : 10,125.0kHz M.CH SW : 4 MIN SW : ON	
	5) FREQ : 14,175.0kHz M.CH SW : 5 MIN SW : ON	
	6) FREQ : 21,225.0kHz M.CH SW : 6 MIN SW : ON	
	7) FREQ : 24,950.0kHz M.CH SW : 7 MIN SW : ON	
	8) FREQ : 28,800.0kHz M.CH SW : 8 MIN SW : ON	

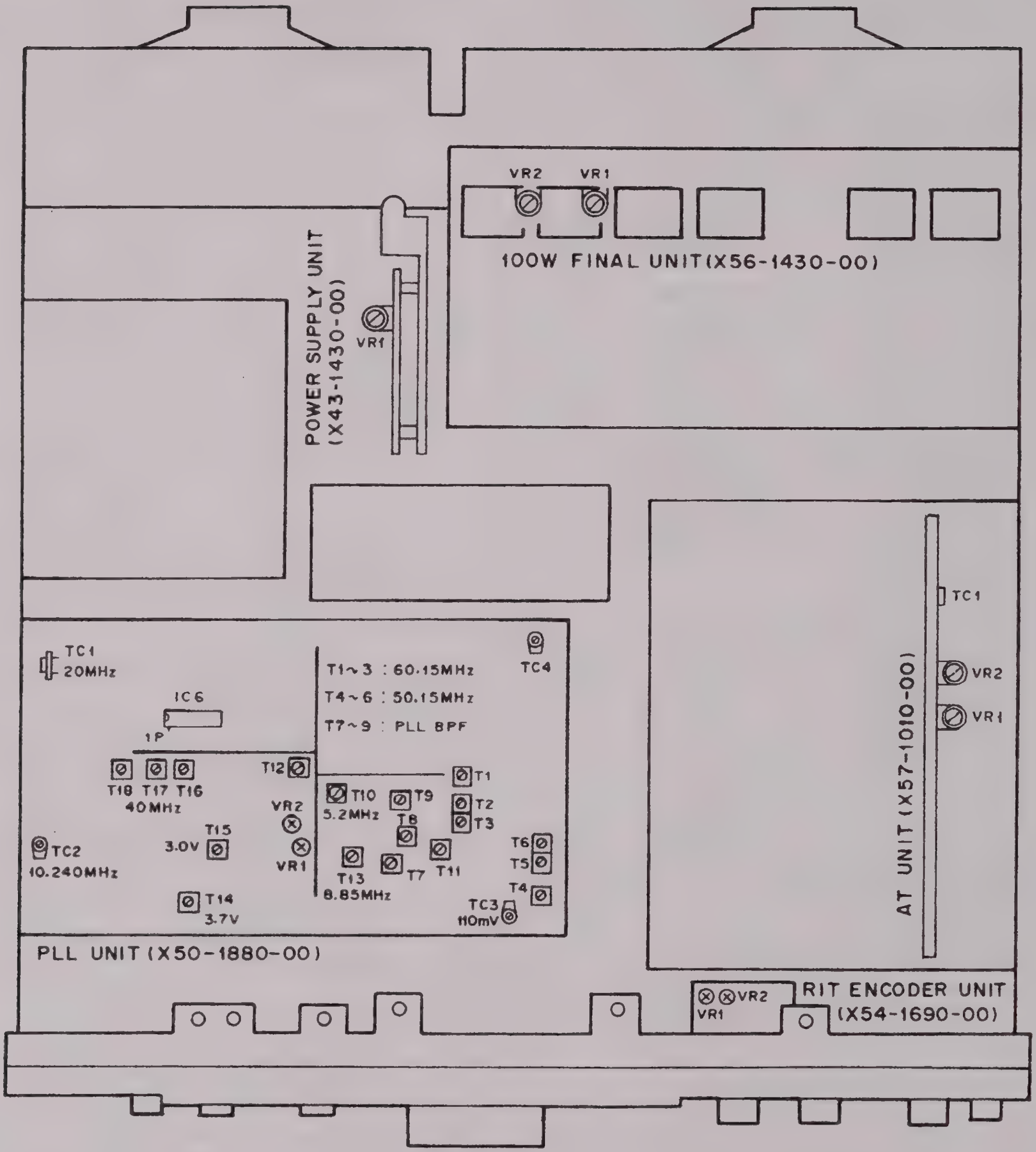
ADJUSTMENT

Item	Condition	Operation check	
6. Memory Recall (1)	1) M.CH SW : 1 MR SW : ON	FREQ : 1,900.0kHz 20kHz analog display : 900	
	Tune VFO up and down.	Displayed frequency increases or decreases.	
	Depress MIN SW again.	Display returns to starting FREQ : 1,900.0kHz, and analog display : 900.	
	2) MODE : LSB MIC CONTROL : MIN STBY : SEND (Return to REC after check.)	FREQ : 1,900.0kHz ANALOG : 900	
	3) MR SW : ON	FREQ.	ANALOG
	M.CH : 2	3,575.0kHz	740
	: 3	7,150.0kHz	140
	: 4	10,125.0kHz	120
	: 5	14,175.0kHz	160
	: 6	21,225.0kHz	220
	: 7	24,950.0kHz	940
	: 8	28,800.0kHz	800
7. Memory Recall (2)	1) VFO/MEMO : MEMO M.CH SW : 1	FREQ : 1,900.0kHz ANALOG : 900	
	Tune VFO up and down.	Display does not change.	
	2) MODE : LSB MIC CONTROL : MIN STBY : SEND (Return to REC after check.)	FREQ : 1,900.0kHz ANALOG : 900	
	3)	FREQ	ANALOG
	M.CH SW : 2	3,575.0kHz	740
	: 3	7,150.0kHz	140
	: 4	10,125.0kHz	120
	: 5	14,175.0kHz	160
	: 6	21,225.0kHz	220
	: 7	24,950.0kHz	940
	: 8	28,800.0kHz	800
	(Return VFO/MEMO SW to VFO after check.)		

Item	Condition	Operation check
8. A=B (FUNCTION)	1) FUNCTION SW : A FREQ : 14,175.0kHz	FREQ : 14,175.0kHz ANALOG : 160
	2) FUNCTION SW : B FREQ : 21,225.0kHz	FREQ : 21,225.0kHz ANALOG : 220
	3) FUNCTION SW : A A=B SW : ON FUNCTION SW : B	FREQ : 14,175.0kHz ANALOG : 160 When A=B SW is depressed, tone sounds.
	4) FUNCTION SW : A FREQ : 14,175.0kHz	FREQ : 14,175.0kHz ANALOG : 160
	5) FUNCTION SW : B FREQ : 21,225.0kHz	FREQ : 21,225.0kHz ANALOG : 220
	A=B SW : ON FUNCTION SW : A	When A=B SW is depressed, tone sounds.
9. MIC UP/ DOWN	1) MODE : USB Connect microphone (MC-60S8 or MC-42S). Depress UP button several times.	When depressed ten times, display increases by 100Hz.
	2) Continuously depress UP button.	When depressed, display increases at 10Hz intervals, and speed becomes gradually faster.
	3) Depress DOWN button several times.	When depressed ten times, display decreases by 100Hz.
	4) Continuously depress DOWN button.	When depressed, display increases at 10Hz intervals and speed becomes gradually faster.
10. D. LOCK	1) D.LOCK SW : ON Turn VFO clockwise or counterclockwise	FREQ. set before D.LOCK was engaged is displayed and does not change.
	2) RIT SW : ON Adjust RIT CONTROL up or down.	Both main, and RIT frequencies change.
	RIT CLEAR SW : ON (Turn off RIT after check.)	Display returns to original FREQ. set before RIT test.
	3) Continuously depress up or down microphone switch.	FREQ. Display increases or decreases regardless of D. LOCK.

ADJUSTMENT

TOP VIEW

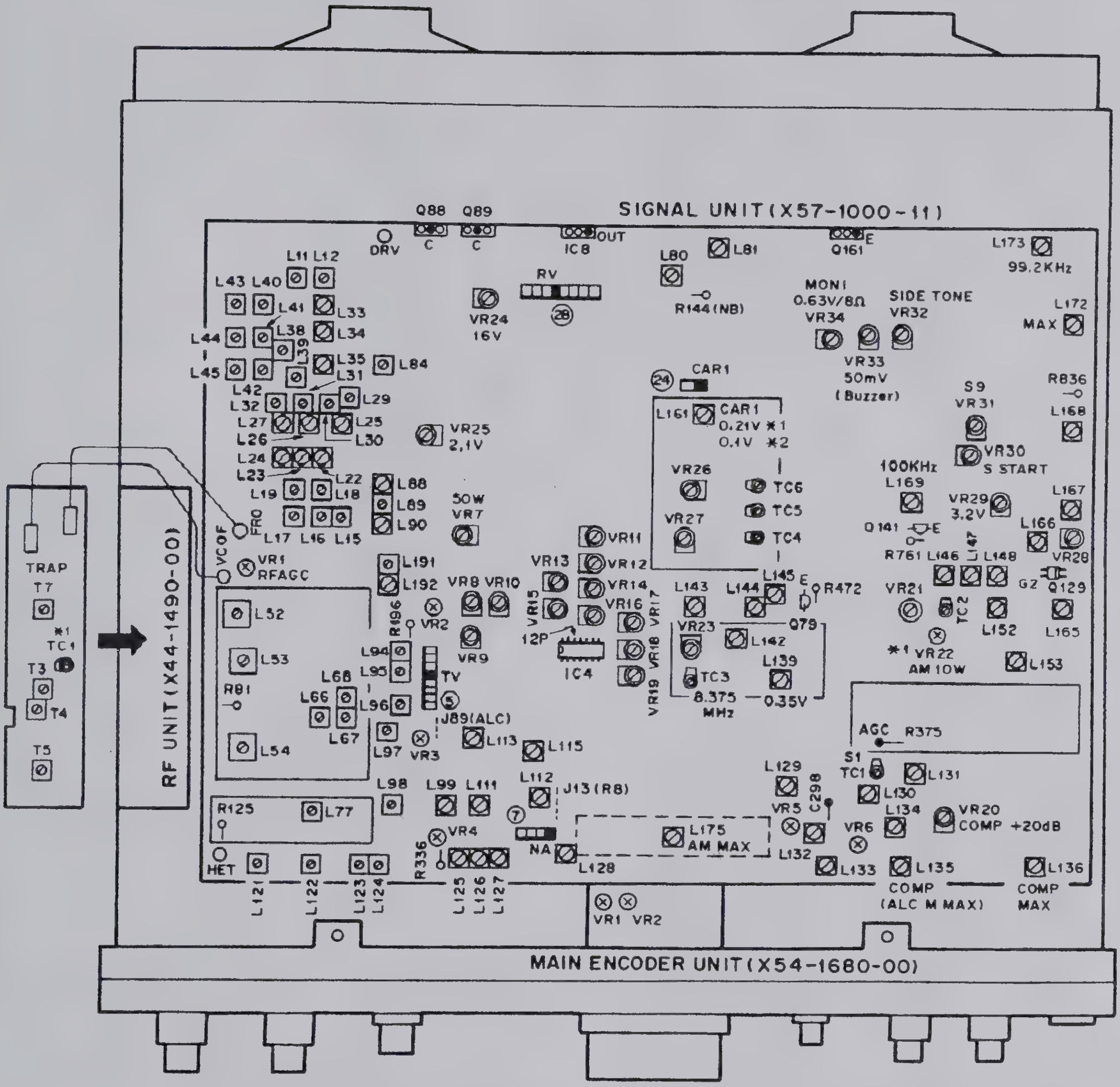

VR2
VR1
100W FINAL UNIT(X56-1430-00)
POWER SUPPLY UNIT (X43-1430-00)
VR1
TC1 20MHz
IC6
1P
T1~3 : 60.15MHz
T4~6 : 50.15MHz
T7~9 : PLL BPF
TC4
T12
T1
T18 T17 T16
40MHz
T10 5.2MHz
T9
T2
T8
T3
VR2
T15
3.0V
VR1
TC2 10.240MHz
T6
T5
T13 8.85MHz
T7
T11
T4
T14 3.7V
TC3 110mV
PLL UNIT (X50-1880-00)
TC1
VR2
VR1
AT UNIT (X57-1010-00)
VR2
VR1
RIT ENCODER UNIT (X54-1690-00)

Caution: Use extreme care when working on energized equipment in the areas of the power transformer, and the ON/OFF switch, as there is voltage present even with the ON/OFF switch in the OFF position.

ADJUSTMENT

BOTTOM VIEW

✱1 : From S/N208XXXX−309XXXX
✱2 : From S/N310XXXX−


SIGNAL UNIT (X57-1000-11)
RF UNIT (X44-1490-00)
MAIN ENCODER UNIT (X54-1680-00)
TRAP
T7
✱1 TC1
T3
T4
T5
Q88 C
Q89 C
DRV
IC8 OUT
RV
㉘
L80
L81
Q161 E
L173 99.2KHz
L11 L12
L43 L40
L41
L33
L44
L38
L34
L39
L45
L35
L31
L84
L42
L32
L29
L27
L25
L26
L30
L24
L23
L22
L19
L18
L17 L16 L15
L88
L89
L90
VR24 16V
VR25 2.1V
50W VR7
R144 (NB)
MONI 0.63V/8Ω VR34
SIDE TONE VR32
VR33 50mV (Buzzer)
L172 MAX
R836
L168
㉔ CAR1
L161
CAR1 0.21V ✱1 0.1V ✱2
S9 VR31
VR30 S START
100KHz L169
VR26
TC6
TC5
TC4
VR27
VR29 3.2V
L167
L166
Q141 E
R761
L146 L147 L148
VR28
G2
Q129
VCOF
FRO
VR1 RFAGC
L191
L192
VR8 VR10
VR13
VR11
VR12
VR14
VR15
VR16
VR17
VR18
VR19
L143
L144
L145
E
R472
VR21
TC2
L152
L165
L52
L53
L54
R81
L68
L66
L67
L94
L95
L96
L97
TV
⑤
J89 (ALC)
R196
VR2
VR9
VR3
12P
IC4
VR23
TC3 8.375 MHz
Q79
L142
L139 0.35V
✱1 VR22 AM 10W
L153
AGC R375
S1 TC1
L131
L130
L134
VR20 COMP +20dB
L113
L115
L129
C298
VR5
VR6
L98
L99
L111
L112
J13 (R8)
⑦
NA
L175 AM MAX
L132
L133
L135 COMP (ALC M MAX)
L136 COMP MAX
R125
L77
HET
VR4
R336
L121
L122
L123
L124
L125
L126
L127
L128
VR1 VR2

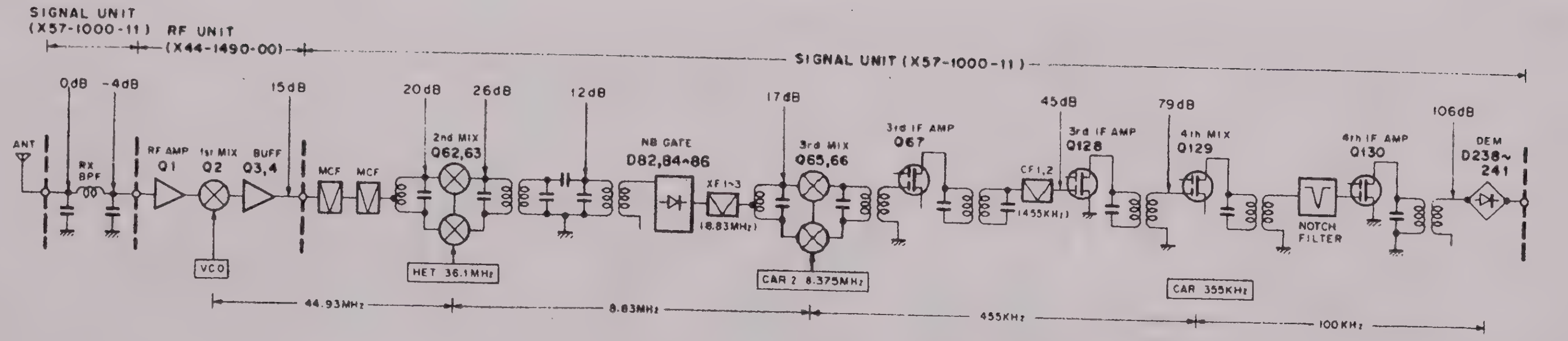
L15−17	: 100−500kHz
L18,19	: 0.5−1.5MHz
L22−24	: 1.5−3.0MHz
L25−27	: 3−4MHz
L29−32	: 4−7MHz
L33−35	: 7−8.5MHz
L38,39	: 8.5−14MHz
L40−42	: 14−20MHz
L11,12,43−45	: 20−30MHz
L52	: 29.9999MHz, 13.0V
L53	: 9.5000MHz
L54	: 45.03MHz±1kHz
L66−68	: 45−75MHz BPF
L113	: MONI MAX
L122	: 44.93MHz MCF
TC2	: TX CAR SUPPRESSION
TC4	: USB FREQUENCY RESPONSE (TX)
TC5	: LSB FREQUENCY RESPONSE (TX)
TC6	: CW 8.830MHz

VR2	: 23.85MHz (TX)
VR3	: 21.900MHz (TX)
VR6	: 21.555MHz (TX)
VR8	: POWER (TX)
VR9	: PROTECTION (TX)
VR10	: 0.42V (TX)
VR11	: ALCφ
VR12	: ALC ZONE
VR13	: 3.2V
VR14	: POWER METER
VR15	: SWR STD 0.5V
VR16	: SWR
VR17	: 10A
VR18	: ICφ (TX)
VR19	: 28.5V
VR21	: TX CAR SUPPRESSION
VR26	: 8827.79kHz FSK

TS-930S LEVEL DIAGRAM

LEVEL DIAGRAM From S/N 208XXXX–309XXXX

RECEIVER SECTION


SIGNAL UNIT (X57-1000-11)
RF UNIT (X44-1490-00)
SIGNAL UNIT (X57-1000-11)
0dB
-4dB
15dB
20dB
26dB
12dB
17dB
45dB
79dB
106dB
ANT
RX BPF
RF AMP Q1
1st MIX Q2
BUFF Q3,4
VCO
MCF
MCF
2nd MIX Q62,63
HET 36.1MHz
NB GATE D82,84~86
XF1~3 (8.83MHz)
3rd MIX Q65,66
CAR 2 8.375MHz
3rd IF AMP Q67
CF1,2 (455KHz)
3rd IF AMP Q128
4th MIX Q129
CAR 355KHz
NOTCH FILTER
4th IF AMP Q130
DEM D238~241
44.93MHz
8.83MHz
455KHz
100KHz

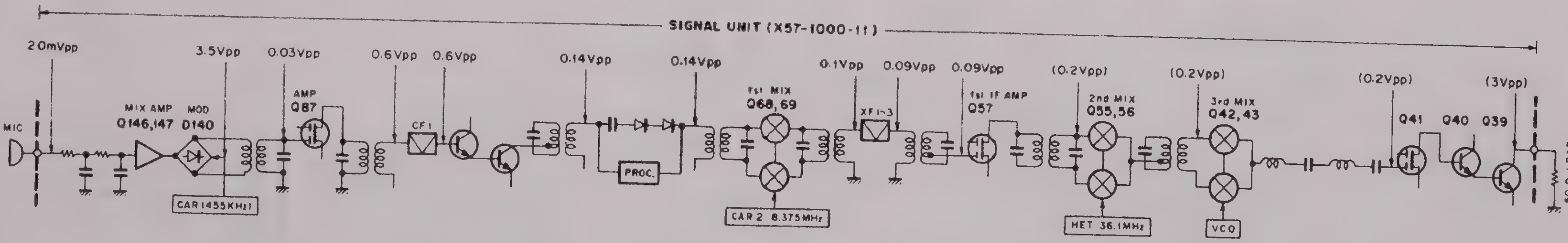
FREQUENCY : 14.200MHz
INPUT : Japanese SSG 0dB
American SSG 0.5μV
AF OUTPUT : 0.63V at 8Ω

NOTES

1) The figures shown are signal generator output required for a constant audio output with a constant AF gain control setting. Set the AF gain control for 0.63V/8Ω (50mW) audio output at 0dB signal generator input at 14.200MHz.

2) To measure signal generator output connect a 0.01μF 500WV capacitor between the signal generator and the check point.

TRANSMITTER SECTION

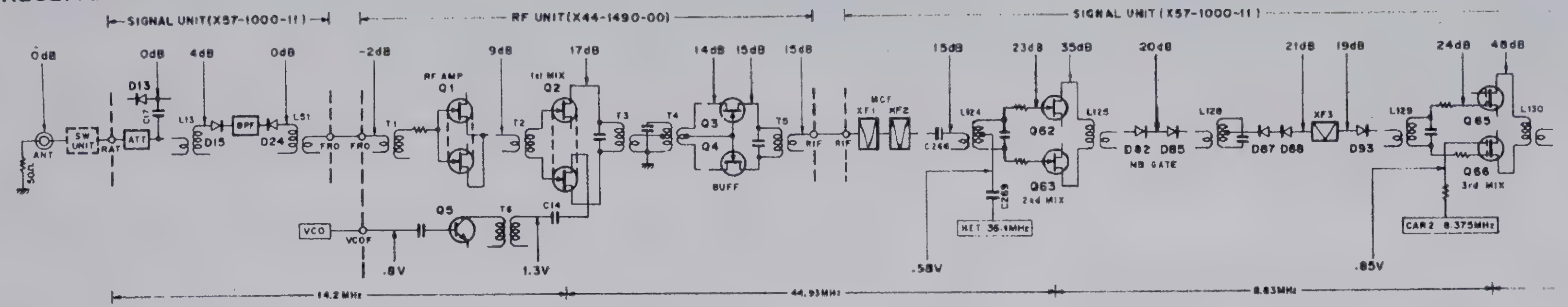

SIGNAL UNIT (X57-1000-11)
20mVpp
3.5Vpp
0.03Vpp
0.6Vpp
0.6Vpp
0.14Vpp
0.14Vpp
0.1Vpp
0.09Vpp
0.09Vpp
(0.2Vpp)
(0.2Vpp)
(0.2Vpp)
(3Vpp)
MIC
MIX AMP Q146,147
MOD D140
CAR (455KHz)
AMP Q87
CF1
PROC.
1st MIX Q68,69
CAR 2 8.375MHz
XF1~3
1st IF AMP Q57
2nd MIX Q55,56
HET 36.1MHz
3rd MIX Q42,43
VCO
Q41
Q40
Q39
50Ω LOAD

FREQUENCY : 14.200MHz
MIC INPUT : 20mVpp 1.5kHz

( ) : Adjust MIC input level so that the voltage at the 50Ω dummy load is 3VPP.

LEVEL DIAGRAM From S/N 310XXXX–

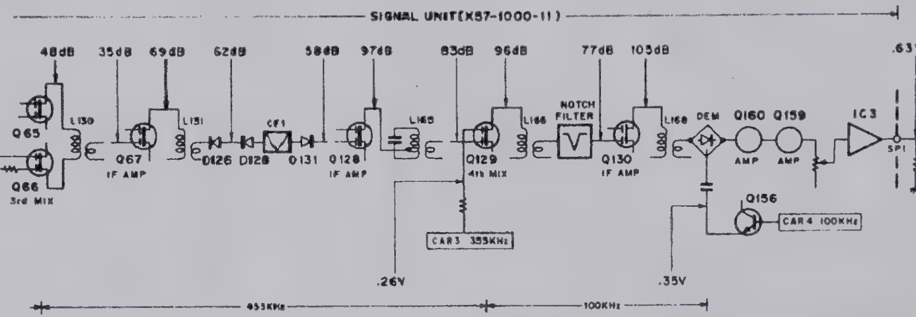
RECEIVER SECTION


SIGNAL UNIT(X57-1000-11)
RF UNIT(X44-1490-00)
SIGNAL UNIT (X57-1000-11)
0dB
0dB
4dB
0dB
-2dB
9dB
17dB
14dB
15dB
15dB
15dB
23dB
35dB
20dB
21dB
19dB
24dB
48dB
ANT
50Ω
SW UNIT
RAT
ATT
D13
C17
L13
D15
BPF
D24
L51
FRO
FRO
T1
RF AMP
Q1
T2
1st MIX
Q2
T3
T4
Q3
Q4
BUFF
T5
RIF
RIF
MCF
XF1
XF2
C244
L124
Q62
Q63
2nd MIX
L125
C269
HET 36.4MHz
D82 D85
NB GATE
L128
D87 D88
XF3
D93
L129
Q65
Q66
3rd MIX
L130
CAR2 8.375MHz
VCO
VCOF
Q5
T6
C14
.8V
1.3V
.58V
.85V
14.2MHz
44.93MHz
8.83MHz

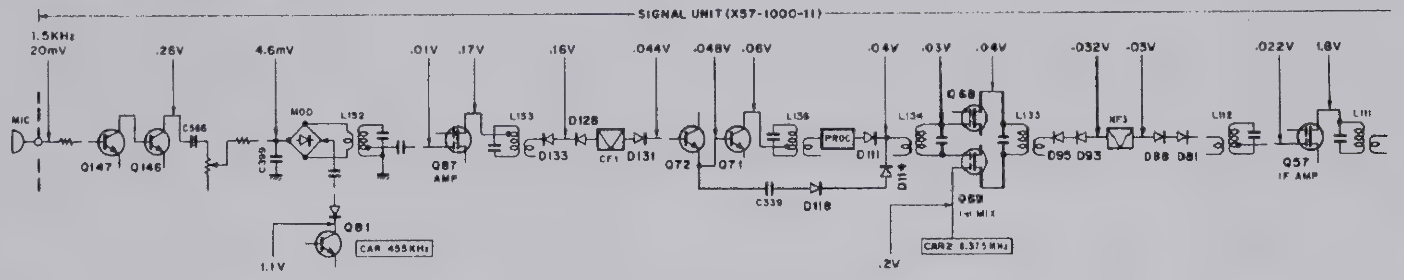
FREQUENCY : 14.200MHz
INPUT : Japanese SSG 0dB (American SSG 0.5μV)
AF OUTPUT : 0.63V/8Ω

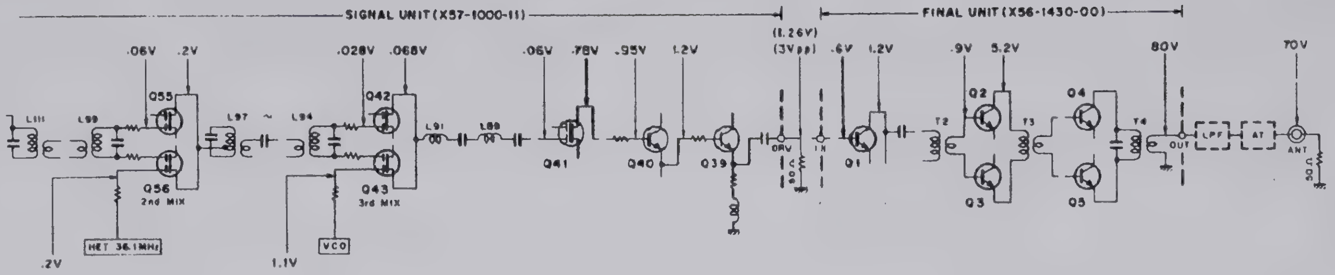
NOTES

1) The figures shown are signal generator output required for a constant audio output with a constant AF gain control setting. Set the AF gain control for 0.63V/8Ω (50mW) audio output at 0dB signal generator input at 14.200MHz.
2) To measure signal generator output connect a 0.01μF 500WV capacitor between the signal generator and the check point.


SIGNAL UNIT(X57-1000-11)
48dB
35dB
69dB
62dB
58dB
97dB
83dB
96dB
77dB
103dB
.63V
Q65
Q66
3rd MIX
L130
Q67
IF AMP
L131
D126
D128
CF1
D131
Q128
IF AMP
L165
Q129
4th MIX
L166
NOTCH FILTER
Q130
IF AMP
L168
DEM
Q160
Q159
AMP
AMP
IC3
SP1
8Ω
CAR3 355KHz
Q156
CAR4 100KHz
.26V
.35V
455KHz
100KHz

TRANSMITTER SECTION

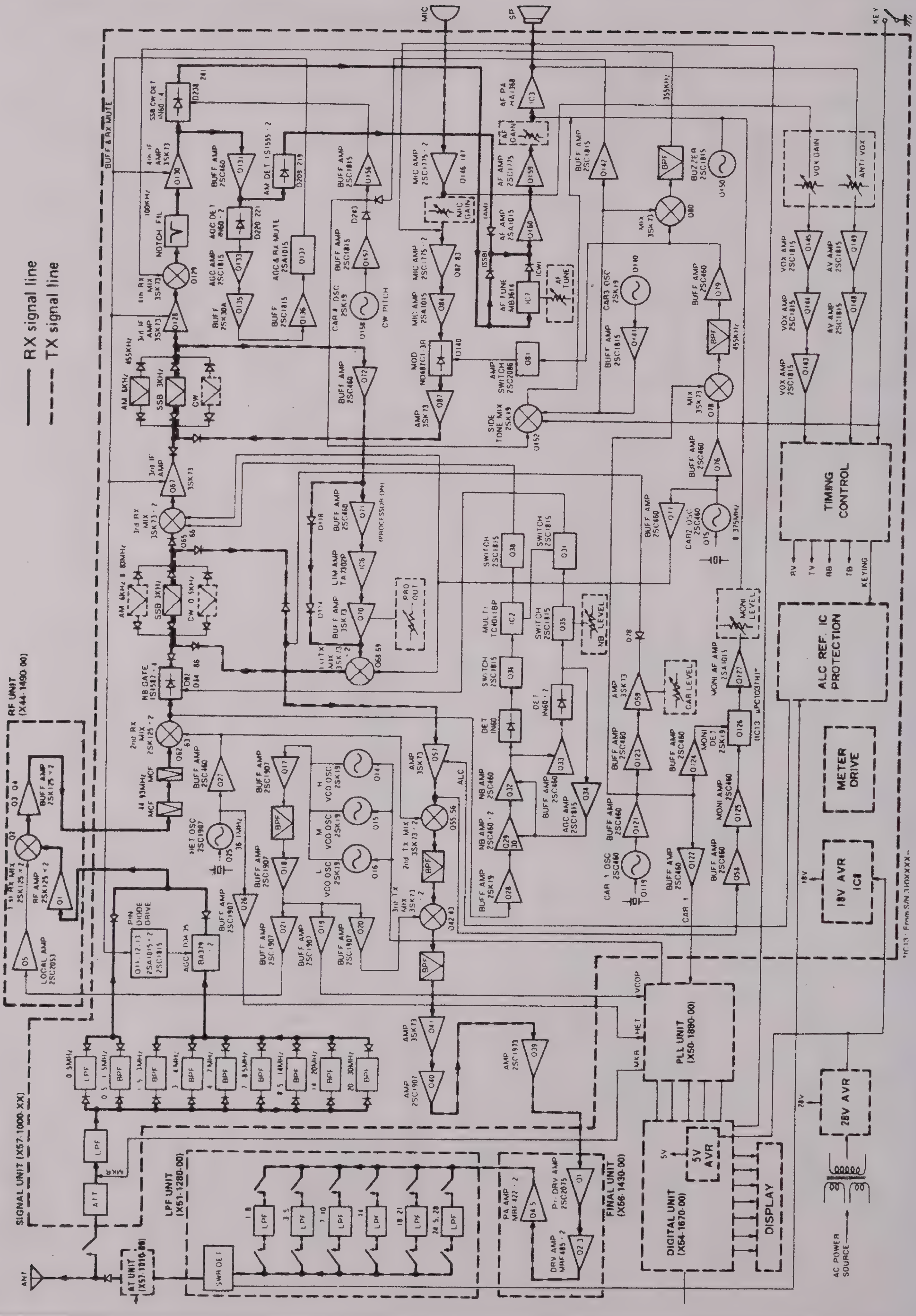

SIGNAL UNIT(X57-1000-11)
1.5KHz
20mV
.26V
4.6mV
.01V
.17V
.16V
.044V
.048V
.06V
.04V
.03V
.04V
-.032V
-.03V
.022V
1.8V
MIC
Q147
Q146
C366
C399
MOD
L152
Q87
AMP
L133
D133
D128
CF1
D131
Q72
Q71
L136
PROC
D111
L134
D114
Q68
Q69
1st MIX
L133
D95 D93
XF3
D88 D81
L112
Q57
IF AMP
L111
C339
D118
Q81
CAR 455KHz
1.1V
CAR2 8.375MHz
.2V


SIGNAL UNIT(X57-1000-11)
FINAL UNIT(X56-1430-00)
.06V
.2V
.028V
.068V
.06V
.78V
.95V
1.2V
(1.26V)
(3Vpp)
.6V
1.2V
.9V
5.2V
80V
70V
L111
L99
Q55
Q56
2nd MIX
L97 ~ L94
Q42
Q43
3rd MIX
L91
L89
Q41
Q40
Q39
DRV
TX
Q1
T2
Q2
Q3
T3
Q4
Q5
T4
OUT
LPF
AT
ANT
50Ω
HET 36.1MHz
VCO
.2V
1.1V

FREQUENCY : 14.200MHz
MIC INPUT : 20mV 1.5kHz

( ) : Adjust MIC input level so that the voltage at the 50Ω dummy is 3Vpp (1.26Vrms).

TS-930S BLOCK DIAGRAM


RX signal line
TX signal line
MIC
SP
KEY
BUFF & RX MUTE
SSB CW DET 1N60 · 4
D238 241
4th IF AMP 3SK73
Q130
100KHz
NOTCH FIL
4th RX MIX 3SK73
Q129
3rd IF AMP 3SK73
Q128
BUFF AMP 2SC460
Q131
AGC DET 1N60 · 2
D220 221
AM DET 1S1555 · 2
D209 219
AGC AMP 2SC1815
Q133
AGC & RX MUTE 2SA1015
Q137
BUFF 2SK30A
Q135
BUFF 2SC1815
Q136
BUFF AMP 2SC1815
Q156
D243
BUFF AMP 2SC1815
Q157
CAR 4 OSC 2SK19
Q158
CW PITCH
MIC AMP 2SC1775 · 2
Q146 147
MIC GAIN
MIC AMP 2SC1775 · 2
Q82 83
MIC AMP 2SA1015
Q84
MOD ND487C1-3R
D140
AMP 3SK73
Q87
(AM)
(SSB)
(CW)
AF AMP 2SC1775
Q159
AF AMP 2SA1015
Q160
AF TUNE MB3614
IC7
AF TUNE
AF PA HA1368
IC3
AF GAIN
AMP SWITCH 2SC2086
Q81
SIDE TONE MIX 2SK19
Q152
BUFF AMP 2SC1815
Q142
BUFF AMP 2SC1815
Q141
CAR3 OSC 2SK19
Q140
MIX 3SK73
Q80
BPF
BUZZER
Q150
355KHz
BUFF AMP 2SC460
Q79
BPF
455KHz
MIX 3SK73
Q78
BUFF AMP 2SC460
Q76
BUFF AMP 2SC460
Q77
CAR2 OSC 2SC460
Q75
8.375MHz
VOX GAIN
ANTI VOX
VOX AMP 2SC1815
Q145
AV AMP 2SC1815
Q149
VOX AMP 2SC1815
Q144
AV AMP 2SC1815
Q148
VOX AMP 2SC1815
Q143
TIMING CONTROL
RV
TV
RB
TB
KEYING
ALC REF. IC PROTECTION
METER DRIVE
18V AVR IC8
18V
*IC13 : From S/N 310XXXX~
AM 6KHz
455KHz
SSB 3KHz
CW
3rd IF AMP 3SK73
Q67
BUFF AMP 2SC460
Q12
3rd RX MIX 3SK73 · 2
Q65 66
AM 6KHz
8.83MHz
SSB 3KHz
CW 0.5KHz
D118
BUFF AMP 2SC460
Q11
(PROCESSOR ON)
LIM AMP TA7302P
IC6
D114
BUFF AMP 3SK73
Q10
PRO OUT
1st TX MIX 3SK73 · 2
Q68 69
NB GATE 1S1587 · 4
D87
D14 86
SWITCH 2SC1815
Q38
SWITCH 2SC1815
Q31
MULTI TC4011BP
IC2
SWITCH 2SC1815
Q35
NB LEVEL
SWITCH 2SC1815
Q36
DET 1N60
DET 1N60 · 2
NB AMP 2SC460
Q32
AGC AMP 2SC460
Q33
AGC AMP 2SC1815
Q34
NB AMP 2SC460 · 2
Q29 30
BUFF AMP 2SK19
Q28
D78
AMP 3SK73
Q59
CAR LEVEL
MONI AF AMP 2SA1015
Q127
MONI LEVEL
IC13 μPC1037H*
MONI DET 2SK19
Q126
BUFF AMP 2SC460
Q123
BUFF AMP 2SC460
Q124
MONI AMP 2SC460
Q125
BUFF AMP 2SC460
Q121
CAR 1 OSC 2SC460
Q119
BUFF AMP 2SC460
Q122
BUFF AMP 2SC460
Q58
CAR 1
RF UNIT (X44-1490-00)
1st RX MIX 2SK125 × 2
Q2
BUFF AMP 2SK125 × 2
Q3 Q4
RF AMP 2SK125 × 2
Q1
LOCAL AMP 2SC2053
Q5
2nd RX MIX 2SK125 · 2
Q62 63
44.93MHz MCF
BUFF AMP 2SC460
Q27
HET OSC 2SC1907
Q25
36.1MHz
BUFF AMP 2SC1907
Q17
BPF
BUFF AMP 2SC1907
Q18
H VCO OSC 2SK19
Q14
M VCO OSC 2SK19
Q15
L VCO OSC 2SK19
Q16
AMP 3SK73
Q57
ALC
2nd TX MIX 3SK73 · 2
Q55 56
BPF
3rd TX MIX 3SK73 · 2
Q42 43
BPF
PIN DIODE DRIVE
Q11 · 12 · 13 2SA1015 · 2 2SC1815
AGC
D34 35
BA379 · 2
BUFF AMP 2SC1907
Q26
BUFF AMP 2SC1907
Q21
BUFF AMP 2SC1907
Q19
BUFF AMP 2SC1907
Q20
AMP 3SK73
Q41
AMP 2SC1907
Q40
AMP 2SC1973
Q39
VCOP
HET
MKR
PLL UNIT (X50-1880-00)
0.5MHz LPF
0.5 · 1.5MHz BPF
1.5 · 3MHz BPF
3 · 4MHz BPF
4 · 7MHz BPF
7 · 8.5MHz BPF
8.5 · 14MHz BPF
14 · 20MHz BPF
20 · 30MHz BPF
LPF
MKR
ATT
SIGNAL UNIT (X57-1000-XX)
LPF UNIT (X51-1280-00)
1.8 LPF
3.5 LPF
7 · 10 LPF
14 LPF
18 · 21 LPF
24.5 · 28 LPF
SWR DET
PA AMP MRF422 · 2
Q4 5
Pr. DRV AMP 2SC2075
Q1
DRV AMP MRF485 · 2
Q2 3
FINAL UNIT (X56-1430-00)
ANT
AT UNIT (X53-1010-00)
DIGITAL UNIT (X54-1670-00)
5V
5V AVR
DISPLAY
28V
28V AVR
AC POWER SOURCE

SP-930

SP-930 SPECIFICATIONS

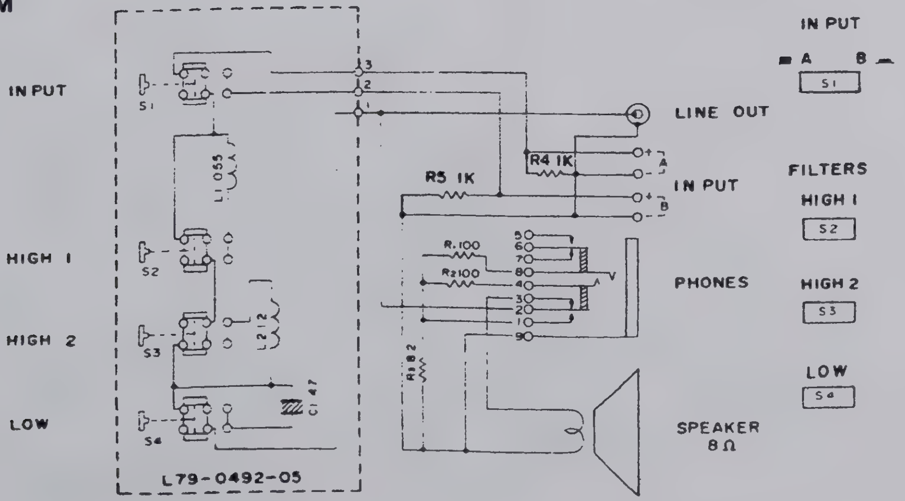
Speaker used:	10 cm dia.
Rated Input:	1.5 Watts
Impedance:	8Ω
Frequency response:	160 Hz to 8kHz.
Filter cut-off frequency,	
LOW:	430Hz, –3dB.
HIGH 1:	2.3 kHz, –3dB.
HIGH 2:	1.0kHz, –3dB.
HIGH 1 + HIGH 2:	730Hz, –3dB.
Filter attenuation:	–6dB/oct.
Dimensions:	W 180 mm (7-1/16") H 140 mm (5-1/2") D 288 mm (11-1/3")
Net weight:	1.9 kg. (4.2 lbs.)
Accessories furnished:	Speaker cord, 1 pc. (E14-0101-05) 1 pin plug, 2 pcs. (E20-1610-05)

PARTS LIST

N : New parts

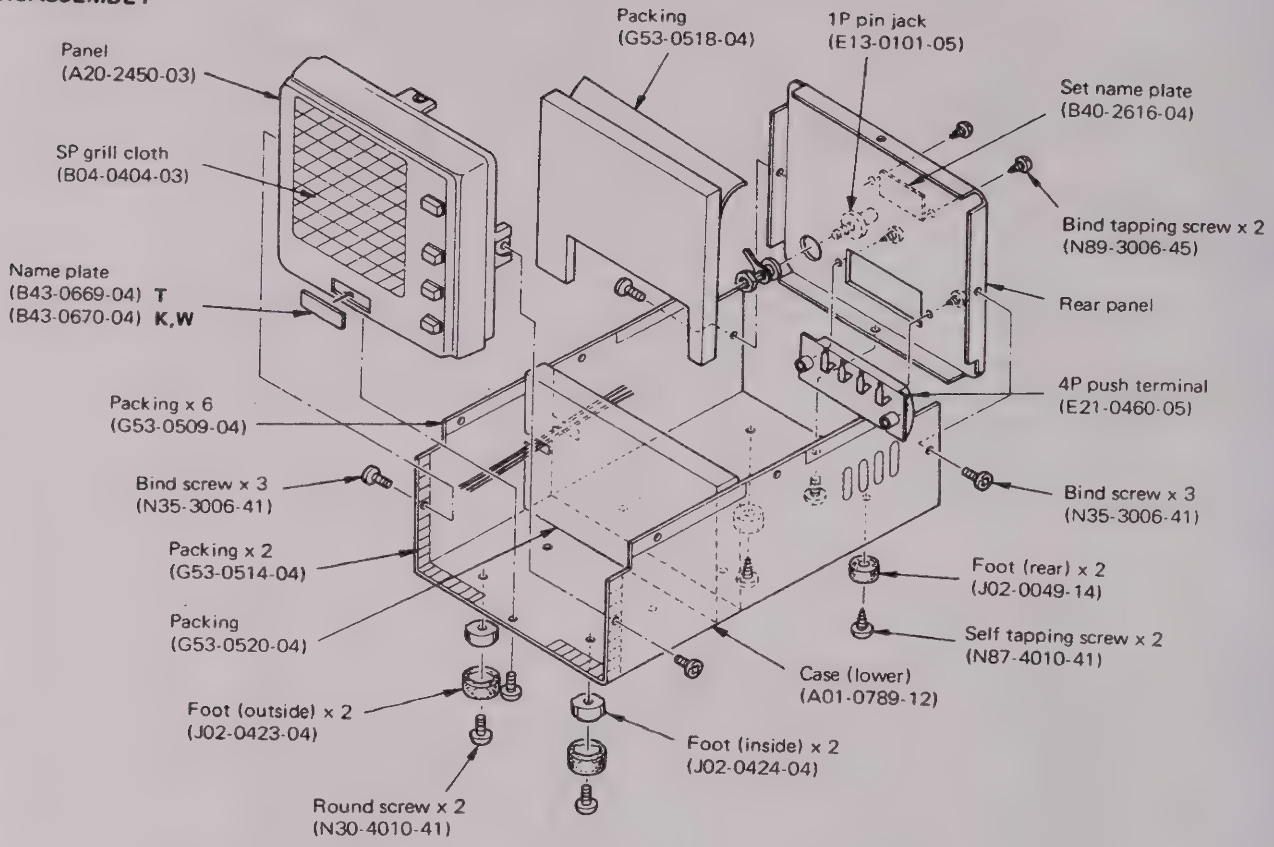
Parts No.	Re-marks	Description	Ref. No.
A01-0789-12		Case (lower)	
A01-0928-03	N	Case (upper)	
A20-2450-03	N	Panel	
B04-0404-03	N	SP grill cloth	
B40-2616-04	N	Set name plate	
B43-0669-04		Name plate T	
B43-0670-04		Name plate K,W	
B46-0404-00	N	Warranty card K	
B50-3980-00	N	Instruction manual K,W	
B50-3981-00	N	Instruction manual T	
CE04BW1E470		E 47 25V	
E11-0404-05		Headphone jack	
E13-0101-05		1P pin jack	
E14-0101-05		1P pin plug Accessory	
E21-0460-05	N	4P push terminal	
E30-1711-15	N	SP cord Accessory	
E40-0373-05		Mini connect wafer 3P	
G53-0509-04		Packing x 6	
G53-0514-04		Packing x 2	
G53-0517-04	N	Packing x 8	
G53-0518-04	N	Packing	
G53-0520-04	N	Packing	
H01-4426-04	N	Packing carton (inside) K,W	
H01-4427-04	N	Packing carton (inside) T	
H12-0500-03	N	Cushion x 2	
H20-0276-03		Protective cover	
H25-0049-03		Protective bag	
J02-0049-14		Foot (rear) x 2	
J02-0423-04		Foot (outside) x 2	
J02-0424-04		Foot (inside) x 2	
J61-0019-05		Vinyle tie x 3	
K29-0757-04		Push knob A,B	
K29-0758-04		Push knob x 3	
L79-0492-05		Filter ass'y	
N30-4010-46		Round screw x 2	
N35-3006-41		Bind screw x 14	
N87-3008-41		Self tapping screw x 4	
N87-4008-46		Self tapping screw x 4	
N87-4010-41		Self tapping screw x 2	
N89-3006-45		Bind tapping screw x 2	
N89-3008-45		Bind tapping screw x 2	
RS14AB3D8R2J		MF 8.2Ω 2W	R3
S40-2436-05		Push switch	
S42-3405-05		Push switch	
T07-0222-05	N	Speaker	

SCHEMATIC DIAGRAM

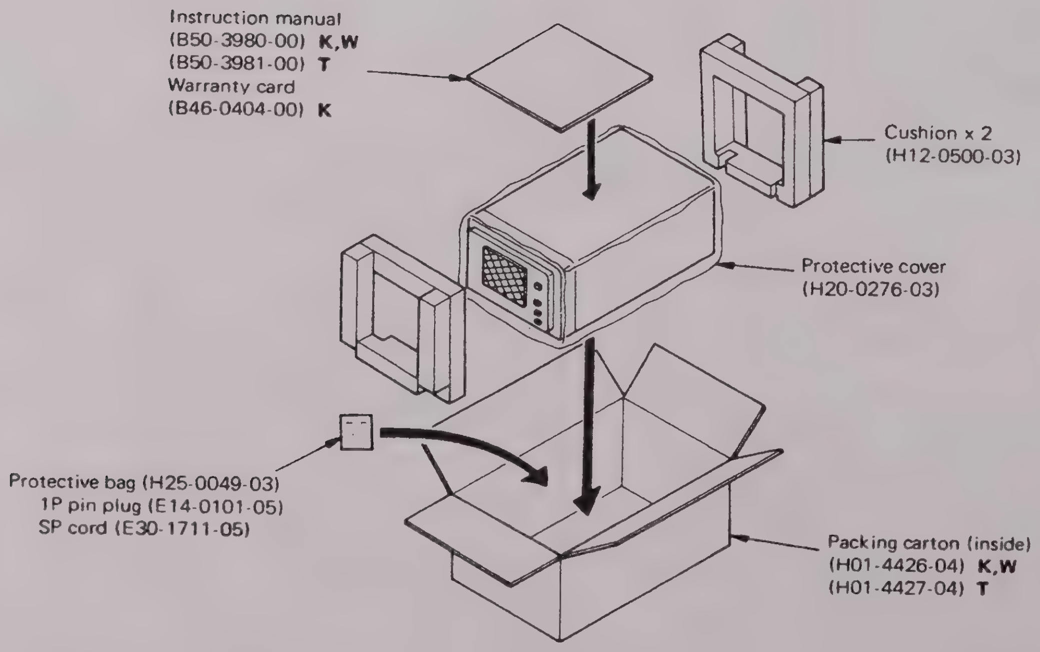


SP-930

DISASSEMBLY


Panel
(A20-2450-03)
SP grill cloth
(B04-0404-03)
Name plate
(B43-0669-04) **T**
(B43-0670-04) **K,W**
Packing x 6
(G53-0509-04)
Bind screw x 3
(N35-3006-41)
Packing x 2
(G53-0514-04)
Packing
(G53-0520-04)
Foot (outside) x 2
(J02-0423-04)
Round screw x 2
(N30-4010-41)
Foot (inside) x 2
(J02-0424-04)
Case (lower)
(A01-0789-12)
Self tapping screw x 2
(N87-4010-41)
Foot (rear) x 2
(J02-0049-14)
Bind screw x 3
(N35-3006-41)
4P push terminal
(E21-0460-05)
Rear panel
Bind tapping screw x 2
(N89-3006-45)
Set name plate
(B40-2616-04)
1P pin jack
(E13-0101-05)
Packing
(G53-0518-04)

PACKING


Instruction manual
(B50-3980-00) **K,W**
(B50-3981-00) **T**
Warranty card
(B46-0404-00) **K**
Cushion x 2
(H12-0500-03)
Protective cover
(H20-0276-03)
Protective bag (H25-0049-03)
1P pin plug (E14-0101-05)
SP cord (E30-1711-05)
Packing carton (inside)
(H01-4426-04) **K,W**
(H01-4427-04) **T**

AT-930

AT-930 SPECIFICATIONS

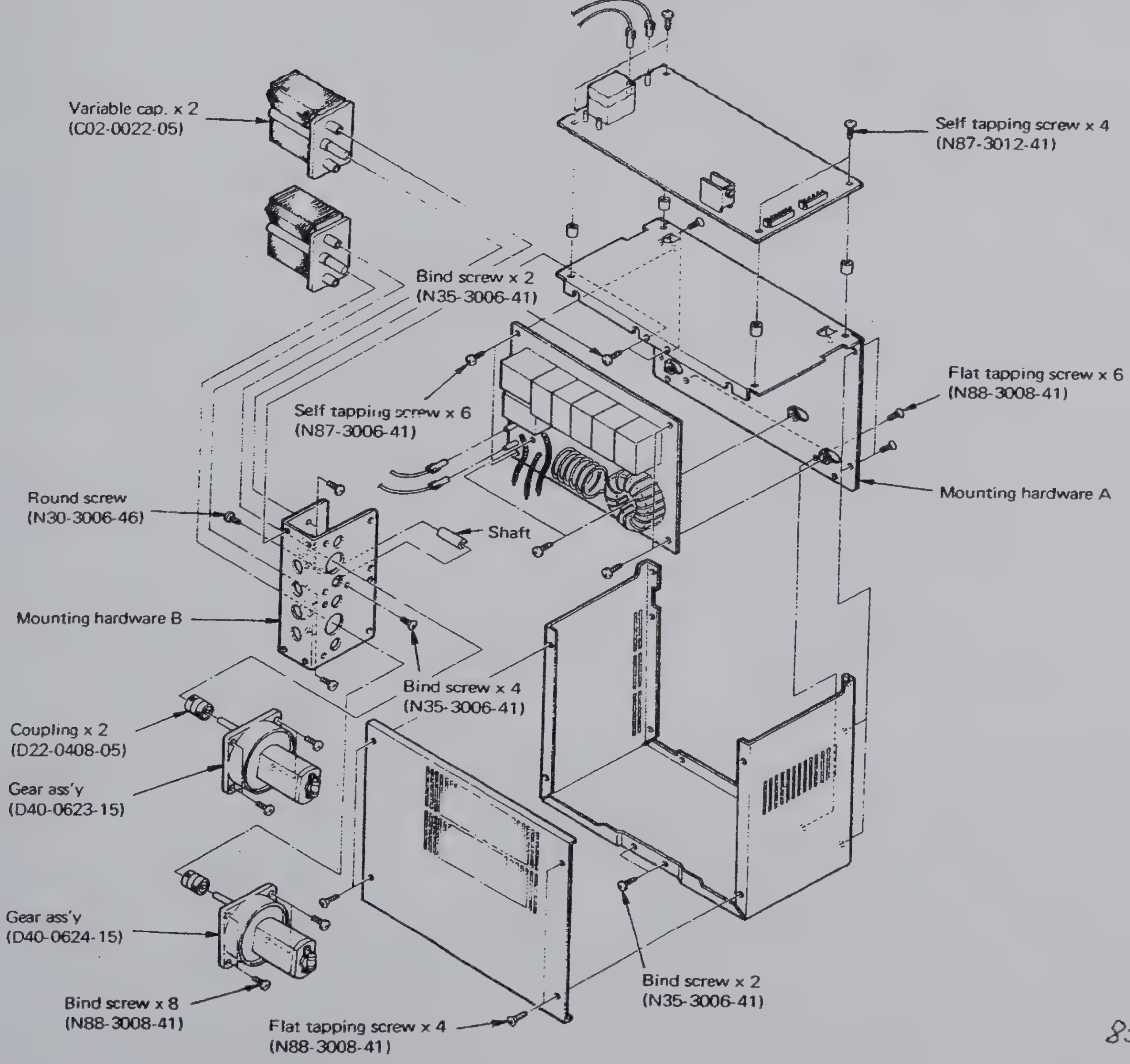
Frequency range:	3.5–29.7 MHz, all amateur bands
Band Selection:	Automatic, by band information from the transceiver.
Input impedance:	50 ohms, unbalanced
Output impedance:	20–150 ohms, unbalanced
Insertion loss:	Less than 1 dB at 29.7 MHz (at best match)
Max. input power:	150W
Motor stop SWR:	Less than 1.2

PARTS LIST

N : New parts

Parts No.	Re-marks	Description	Ref No.
B46-0407-00	N	Warranty card K	
B50-3971-00	N	Instruction manual	
H01-4419-03	N	Packing carton (inside)	
H12-0494-04	N	Cushion x 2	
H25-0029-04		Protective bag Accessory	
H25-0106-04		Protective cover	
N87-3006-46		Self tapping screw x 4	
X57-1010-00	N	AT unit	

DISASSEMBLY


Variable cap. x 2
(C02-0022-05)
Self tapping screw x 4
(N87-3012-41)
Bind screw x 2
(N35-3006-41)
Flat tapping screw x 6
(N88-3008-41)
Self tapping screw x 6
(N87-3006-41)
Round screw
(N30-3006-46)
Mounting hardware A
Shaft
Mounting hardware B
Bind screw x 4
(N35-3006-41)
Coupling x 2
(D22-0408-05)
Gear ass'y
(D40-0623-15)
Gear ass'y
(D40-0624-15)
Bind screw x 8
(N88-3008-41)
Flat tapping screw x 4
(N88-3008-41)
Bind screw x 2
(N35-3006-41)

KENWOOD

SERVICE MANUAL

TS-930S SP-930, AT-930, SO-1

HF TRANSCEIVER

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SO-1 .... BACK COVER
INTERCONNECT & SIGNAL UNIT SCHEMATIC ..... INSERT

SPECIFICATIONS

[GENERAL]

Transmitter Frequency Range:	160 m Band 1.8 ~ 2.0 MHz 80 m Band 3.5 ~ 4.0 MHz 40 m Band 7.0 ~ 7.3 MHz *30 m Band 10.1 ~ 10.15 MHz (10.0 MHz WWV) 20 m Band 14.0 ~ 14.35 MHz *17 m Band 18.068 ~ 18.168 MHz 15 m Band 21.0 ~ 21.45 MHz *12 m Band 24.89 ~ 24.99 MHz 10 m Band 28.0 ~ 29.7 MHz
Receiver Frequency Range:	150 kHz - 30 MHz
Mode:	A3J (USB, LSB), A1 (CW), F1 (FSK), A3 (AM)
Antenna Impedance:	50 ohms
With AT-930 antenna tuner	20 - 150 ohms (80 - 10 meter Amateur bands only)
Power Requirement:	120/220/240 VAC, 50/60 Hz
Power Dissipation:	Max. 510 W during transmission, 80 W during reception
Dimensions:	374(14-3/4")W × 141 (5-9/16")H × 350(13-13/16")D mm (inches)
Weight:	With antenna tuner: Approx. 18.5 kg (40.8 lbs) Without antenna tuner: Approx. 16.8 kg (37.0 lbs)

[TRANSMITTER]

Final Power Input:	SSB/CW/FSK 250 W AM 80 W
Carrier Suppression:	Better than 40 dB
Unwanted Sideband Suppression:	Better than 50 dB (with 1 kHz modulation)
Harmonic Content:	Less than −40 dB
Audio Frequency Response:	400 - 2,600 Hz/−6 dB
Modulation:	SSB: Balanced modulation AM: Low level modulation (IF stage)
FSK Shift:	170 Hz
Modulation Distortion:	Less than −31 dB
Microphone Impedance:	500 ohms or 50 kohms (Connector - switchable)
ALC Input:	−10 V DC MAX
Linear Amplifier Switching:	200 V DC MAX 100 mA

[RECEIVER]

Circuitry:	Quadruple conversion
Intermediate Frequencies:	1st IF: 44.93 MHz 2nd IF: 8.83 MHz 3rd IF: 455 kHz 4th IF: 100 kHz
Sensitivity (at 10 dB S+N/N) 150 - 500 kHz:	Less than 1 μV for SSB, CW and FSK Less than 10 μV for AM
500 kHz - 1.8 MHz:	Less than 4 μV for SSB, CW and FSK Less than 32 μV for AM
1.8 - 30 MHz:	Less than 0.25 μV for SSB, CW and FSK Less than 2 μV for AM
Image Ratio:	More than 80 dB (1.8 MHz ~ 30 MHz)
IF Rejection:	More than 70 dB (1.8 MHz ~ 30 MHz)
Selectivity (W-wide, N-narrow filter selection)	
SSB, CW(W), FSK(W), AM(N):	2.7 kHz/−6 dB, 4.0 kHz/−60 dB
CW(N), FSK(N):	Without optional filter: same as CW(W), FSK(W) With optional YG-455C-1: 500 Hz/−6 dB, 820 Hz/−60 dB With optional YG-455CN-1: 250 Hz/−6 dB, 480 Hz/−60 dB With optional YK-88C-1: 500 Hz/−6 dB, 1.5 kHz/−60 dB
AM(W):	Without optional filter: 6 kHz/−6 dB, 18 kHz/−60 dB With optional YK-88A-1: 6 kHz/−6 dB, 11 kHz/−60 dB
SSB Slope Tune:	High-cut: More than 1500 Hz shift/−6 dB Low-cut: More than 700 Hz shift/−6 dB
CW VBT	
CW(W), FSK(W) AM(N):	600 Hz ~ 2.7 kHz/−6 dB
CW(N), FSK(N):	Without optional filter: same as CW(W), FSK(W) With optional YK-88C-1 and YG-455C-1 installed: 150 Hz ~ 500 Hz −6 dB
AM(W):	With optional YK-88A-1: 4 kHz ~ 6 kHz/−6 dB
Frequency Stability:	Within ±200 Hz after turn-on Within ±30 Hz any 30 minute period there after at constant temperature
Frequency Accuracy:	$\pm 1 \times 10^{-5}$ or better (at normal temperatures)
RIT Variable Range:	±9.99 kHz
Notch Filter Attenuation:	More than 40 dB
Phone Patch Output Z:	600 Ω
Audio Output Power:	More than 1.5 W across 8 Ω (at 10% distortion)

AT-930 (Automatic Antenna Tuner)

Frequency Range:	Amateur bands from 80 ~ 10 m
Input Impedance:	50 Ω, unbalanced
Output Impedance:	20 ~ 150 Ω unbalanced
Insertion Loss:	Less than 1 dB at 3.5 MHz (at optimum match)
Through Power:	150 W max.
Motor Stop SWR Value:	Less than 1.2

*Will transmit on the new 30, 17, and 12 meter bands. Lock-out circuitry installed to prevent accidental transmission before government amateur authorization.

NOTE: The circuit and ratings may change without notice due to developments in technology.

CIRCUIT DESCRIPTION

GENERAL

The TS-930S receiver is quadraple conversion and the transmitter is double conversion in the TUNE mode and triple conversion in the SSB, AM and FSK modes. Fig. 1 shows the frequency configuration of the receiver and Fig. 2 shows that of the transmitter.

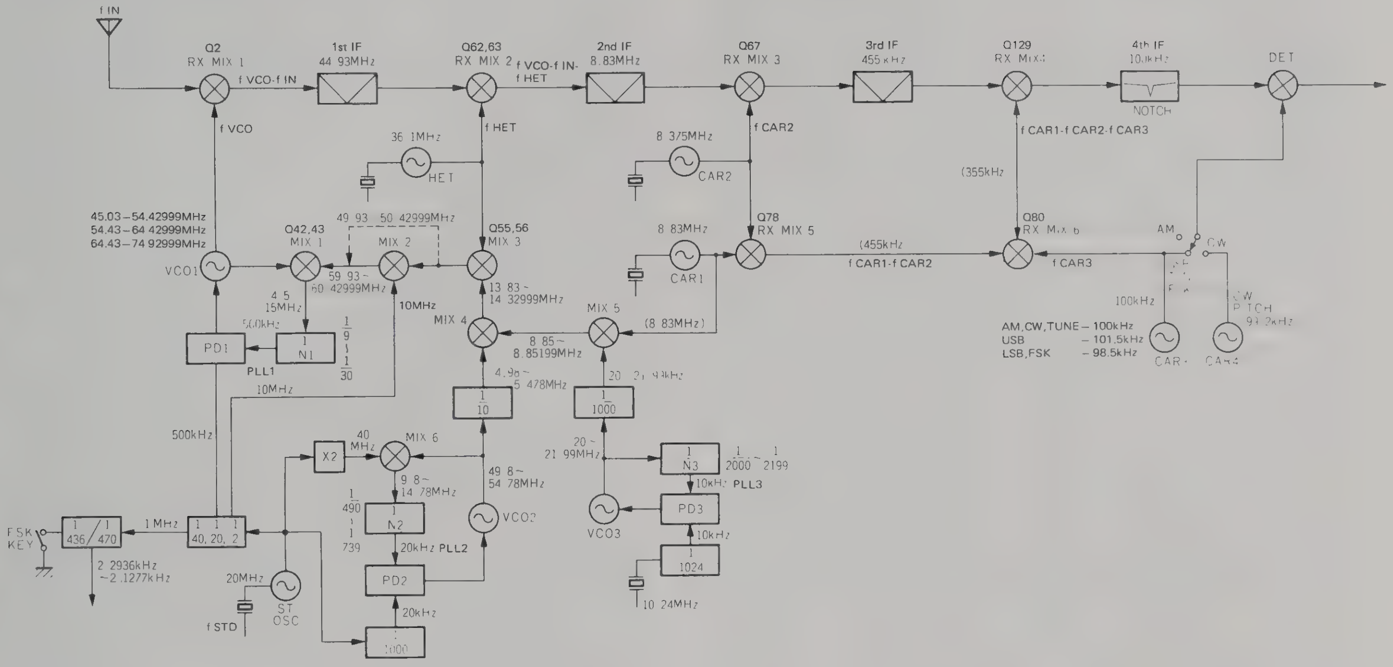

f IN
Q2
RX MIX 1
f VCO-f IN
1st IF
44 93MHz
Q62,63
RX MIX 2
f VCO-f IN-
f HET
2nd IF
8.83MHz
Q67
RX MIX 3
3rd IF
455 kHz
Q129
RX MIX4
4th IF
100kHz
NOTCH
DET
f VCO
f HET
36 1MHz
HET
f CAR2
8 375MHz
CAR2
f CAR1-f CAR2-f CAR3
(355kHz
45.03–54.42999MHz
54.43–64 42999MHz
64.43–74 92999MHz
VCO1
Q42,43
MIX 1
49 93 50 42999MHz
MIX 2
59 93~
60 42999MHz
Q55,56
MIX 3
8 83MHz
CAR1
Q78
RX MIX 5
(455kHz
f CAR1-f CAR2
Q80
RX MIX 6
f CAR3
AM
CW
4 5
15MHz
500kHz
PD1
1/N1
1/9 ~ 1/30
PLL1
10MHz
13 83 ~
14 32999MHz
MIX 4
8 85~
8.85199MHz
MIX 5
(8 83MHz)
100kHz
AM,CW,TUNE – 100kHz
USB – 101.5kHz
LSB,FSK – 98.5kHz
CAR3
CW PITCH
99 2kHz
CAR4
4.98~
5 478MHz
1/10
20 21 99kHz
1/1000
500kHz
X2
40 MHz
MIX 6
9 8~
14 78MHz
49 8~
54 78MHz
20~
21 99MHz
1/N3
1/2000 ~ 1/2199
10kHz PLL3
1/490 ~ 1/739
1/N2
VCO2
PD3
VCO3
10kHz
20kHz PLL2
1/1024
FSK KEY
1/436 / 1/470
1MHz
1/40, 1/20, 1/2
2 2936kHz
~2 .1277kHz
20MHz
ST OSC
f STD
PD2
20kHz
1/1000
10 24MHz

Fig. 1 RX Frequency configuration

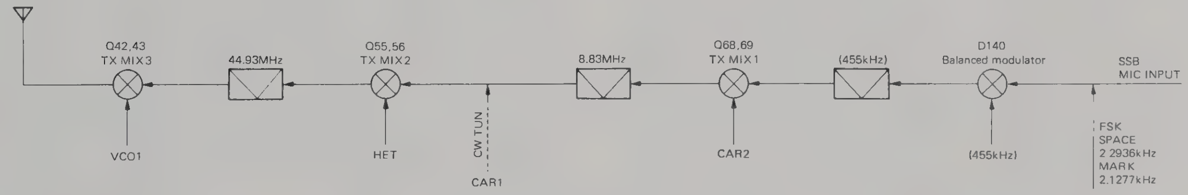

Q42,43
TX MIX3
44.93MHz
Q55,56
TX MIX2
8.83MHz
Q68,69
TX MIX1
(455kHz)
D140
Balanced modulator
SSB
MIC INPUT
VCO1
HET
CW TUN
CAR1
CAR2
(455kHz)
FSK
SPACE
2 2936kHz
MARK
2.1277kHz

Fig. 2 TX Frequency configuration

● VCOs (voltage controlled oscillators) in the Signal unit

There are three VCOs in the Signal unit X57-1000-11. Q16 operates at 45.03 to 54.42999MHz, Q15 at 54.43 to 64.42999MHz and Q14 at 64.43 to 74.9299MHz, the first VCO is used for operation from 100kHz to 9.49999MHz, the second from 9.5 to 19.49999MHz and the last from 19.5 to 29.99999MHz.

● HET (heterodyne) generation in the Signal unit

Oscillator Q25 uses a 3rd overtone crystal to generate a 36.1MHz heterodyne signal.

● CAR 1 in the Signal unit

Q119 operates at 8.83MHz with crystal X5 for the CW, TUNE and AM modes ; at 8.8315MHz with X3 for the USB mode ; and at 8.8285MHz with X4 for the LSB and FSK modes. (CAR 1 frequency shifts to 8.82779MHz in the FSK mode.) The CAR 1 oscillator is a VXO (variable crystal oscillator) which, together with the CAR 2 oscillator, forms the SSB-slope-tune and CW-VBT circuits.

● CAR 2 in the Signal unit

Q75 is a VXO, operating at 8.375MHz.

● CAR 3 in the Signal unit

Q140 operates at 100kHz for the CW, TUNE and AM modes ; at 101.5kHz for the USB mode ; and at 98.5kHz for the LSB mode. This output is fed to the 2nd CAR mixer Q80 and to Q152 as signal CAR in the SSB, TUNE and FSK modes and as the carrier in the CW mode.

● CAR 4 in the Signal unit

Q158 operates at 99.2kHz and is used for both demodulating CW signals and generating the CW side tone.

CIRCUIT DESCRIPTION

RX SECTION

The signal from the antenna is applied to the Signal unit X57-1000-11 RAT terminal, then applied to a low pass filter or one of 8 band pass filters through a 10dB or 20dB RF attenuator. The filters are selected according to BAND data (RB0 – RB3) output from the Digital unit X54-1670-00. Frequencies of these filters are shown in Table 1. The signal is then passed through the RF AGC circuit consisting of PIN diodes D34 and D35 (BA379) and is fed to the RF unit X44-1490-00 via the RRF terminal. In the RF unit, the signal is amplified by a matched pair of 2SK125s (Q1 a & b) and mixed with the VCO signal by the first RX mixer, another pair of 2SK125s (Q2), to obtain the 44.93MHz first IF signal. This is buffered by amplifiers Q3 and Q4 and fed back to the Signal unit via the RIF terminal. In the Signal unit, the 1st IF signal is filtered by an MCF (monolythic crystal filter), which has a bandwidth of approximately 10kHz, and is then applied to the 2nd RX balanced mixer. There, it is mixed with the 36.1MHz HET signal to obtain the 8.83MHz 2nd IF signal.

The 2nd IF signal is applied to both the noise blanker circuit and the noise blanking gate (diodes D82, D84, D85 and D86). The signal, passing through the noise blanking gate, is then applied to filter XF1. (The standard XF1 is a 3kHz SSB filter ; optional 500Hz CW (XF2) and 6kHz AM (XF3) filters are also available.) The filtered SSB signal is then mixed with the 8.8375MHz CAR 2 signal by the 3rd RX balanced mixer, Q65 and Q66 (3SK73s), to obtain the 455kHz 3rd IF signal. The 3rd IF signal is amplified approximately 30dB by IF amplifier Q67, then filtered by a ceramic filter. (CF1, 3kHz and CF2, 6kHz filters are built in, and optional 500Hz or 250Hz XF4 CW filters are also available.) The signal is then amplified 30dB by Q128 and mixed with a 355kHz signal by the 4th RX mixer Q129 to obtain the 100kHz 4th IF signal. This signal passes the notch circuit, and is IF amplified by Q130, and detected by either the SSB and CW detector D238 – 241, or the AM detector, depending on the mode. The detected audio signal is amplified by the 2-stage AF amplifier Q159, 160, then power amplified by IC3 to drive the speaker.

BAND	Frequency (MHz)
A	~ 0.5
B	0.5 ~ 1.5
C	1.5 ~ 3
D	3 ~ 4
E	4 ~ 7
F	7 ~ 8.5
G	8.5 ~ 14
H	14 ~ 20
I	20 ~ 30

Table 1 RX BPF frequency

TX SECTION

The microphone signal is applied to the microphone input terminal MCL (for 500Ω microphones). Terminal MCH is provided for 50kΩ microphone and is selected by moving the connector. The MIC amplifier, consisting of Q146 and Q147, amplifies the signal by approximately 34dB when the MCL terminal is used. The amplifier gain is about 14dB when the MCH terminal is used. The amplified signal is applied to the MIC gain control, then applied to amplifiers Q82 and Q83 via terminal MV2. After being amplified by Q82 and Q83, the signal is applied to balanced modulator D140 (ND487C1-3R, a Schottky diode package) where a 455kHz DSB signal is obtained. The 455kHz DSB signal is buffer amplified by Q87 and is converted to a 455kHz SSB signal by CF1. This signal is applied to the RF speech processor consisting of Q71, IC6 and Q70 through buffer amplifier Q72. The processor output signal is applied to the 1st TX mixer, Q68 and Q69. When the processor is off, it is bypassed, and the signal continues through diodes D118 and D114. The 455kHz SSB signal is mixed with the 8.375MHz CAR 2 signal by the 1st TX mixer to obtain an 8.83MHz signal, which is then applied to filter XF1, where the unwanted side band introduced by the speech processor is removed. The signal is then amplified by IF amplifier Q57. ALC signal is applied to the 2nd gate of Q57. In the CW and TUNE modes, the 8.83MHz CAR 1 signal is fed directly to IF amplifier Q57 through buffer amplifiers Q121 and Q123, amplifier Q59 and switching diode D78. Full break-in is possible in these modes because the transmission signal does not pass through the narrow band filter. The signal output by Q57 is applied to the monitor circuit through buffer amplifier Q58. The signal is also applied to the TX 2nd mixer Q55 and Q56, where it is mixed with the 36.1 MHz HET signal to obtain the 44.93MHz signal. The converted signal is then mixed with the VCO signal by the TX 3rd mixer Q42 and Q43, to obtain the operating frequency.

It is then amplified approximately 22dB by wide band amplifiers Q41, Q40 and Q43, after unwanted signal components are removed by one of the TX band pass filters. The amplified signal is output from the DRV terminal and fed to the Final unit X56-1430-00. The drive signal line to the Final unit is automatically disconnected when a cable is connected to the transverter connector on the rear panel.

In the Final unit, the signal is amplified approximately 40dB by a three-stage wide band amplifier consisting of pre-driver Q1 (2SC2075), a push-pull driver (Q2 and Q3 ; MRF485s) and a push-pull final amplifier (Q4 and Q5 ; MRF422s). The amplified signal is then applied to the antenna through the Filter unit X51-1280-00, (optional) AT (antenna tuner) unit X57-1010-00 and Switch unit X41-1410-00. There are two models of the TS-930S : one with and one without the AT unit. The final amplifier uses

CIRCUIT DESCRIPTION

Motorola transistors, having an excellent IMD (intermodulation distortion) characteristic, a maximum collector dissapation (PC) of 290W and high reliability. 28V DC is applied to each transistor. The bias circuits for the predriver and driver are regulated by varistors and a transistor. The bias circuit for the final transistors is regulated by IC1 and Q7, and the diode characteristic between the base and emitter of the transistor is used to provide temperature compensation and is controlled by the heat sink temperature in proximity to the final transistors.

PLL CIRCUIT

The TS-930S uses a 10Hz step digital VFO to control the operating frequency. Fig. 3 shows a block diagram of the PLL unit X50-1880-00. The PLL circuit uses three separate PLL loops (PLL-1, PLL-2 and PLL-3) to vary the operating frequency from 100kHz to 30MHz.

PLL-3 consists of IC13 and its peripheral circuitry. VCO-3 (Q29) operates within the 20 to 21.99MHz range. IC13 incorporates a divider and phase detector, and divides (by 1024) the 10.24MHz signal generated by X2 to obtain the 10kHz reference signal. The signal output by VCO-3 is applied to IC13 pin 9 through amplifier Q28 and is divided (by a value ranging from 2000 to 2199) to obtain 10kHz. The phase of this 10kHz signal is compared with that of the 10kHz reference signal to lock VCO-3. The locked VCO-3 signal is applied to IC9 pin 14 through buffer Q33. The signal is divided by 1000 in IC9, IC10 and IC11 to obtain a signal which varies in 10Hz steps in the 20 to 21.99kHz range. The frequency division data for IC13 is delivered serially from the microprocessor in the Digital unit X54-1670-00.

PLL-2 consists of IC15 and its peripheral circuitry. VCO-2 (Q25) operates in the 49.8 to 54.78MHz range. The 20MHz signal generated by Q36 is applied to IC15 pin 19 through buffer Q34. This signal is divided by 1000 by IC15 to obtain the 20kHz reference signal. The VCO-2 signal is applied to IC14 (MIX 6) pin 2 through buffer Q26, where it is mixed with the 40MHz signal obtained by doubling the 20MHz signal from Q34 so that an output varying from 9.8 to 14.78MHz is obtained. This signal is applied to IC15 pin 10 through amplifier Q21 and is divided by a value ranging form 490 to 739 to obtain the 20kHz signal. The phase of this 20kHz signal is compared with that of the 20kHz reference signal to lock VCO-2. The VCO-2 output signal is applied to IC8 pin 2 through buffer Q27 and divided by 10 to obtain a signal which varies in 2kHz steps in the 4.98 to 5.478MHz range. The frequency division data for IC15 is also delivered serially from the microprocessor in the Digital unit. The 4.98 to 5.478MHz signal output from IC8 pin 5 is applied to IC6 (MIX 4) pin 2.

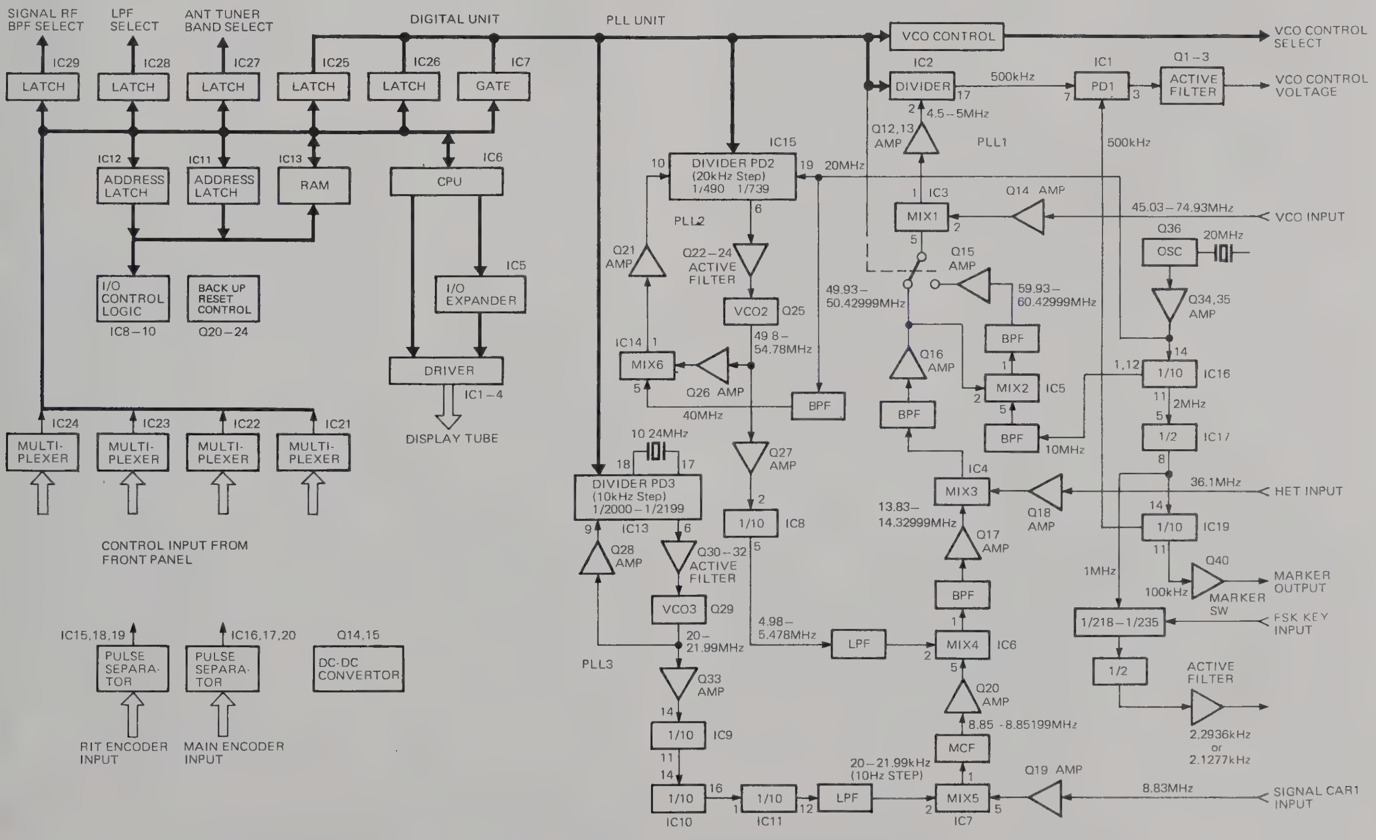

SIGNAL RF BPF SELECT
LPF SELECT
ANT TUNER BAND SELECT
DIGITAL UNIT
PLL UNIT
IC29
IC28
IC27
IC25
IC26
IC7
LATCH
LATCH
LATCH
LATCH
LATCH
GATE
IC12
IC11
IC13
IC6
ADDRESS LATCH
ADDRESS LATCH
RAM
CPU
IC5
I/O CONTROL LOGIC
BACK UP RESET CONTROL
I/O EXPANDER
IC8–10
Q20–24
DRIVER
IC1–4
DISPLAY TUBE
IC24
IC23
IC22
IC21
MULTI-PLEXER
MULTI-PLEXER
MULTI-PLEXER
MULTI-PLEXER
CONTROL INPUT FROM FRONT PANEL
IC15,18,19
IC16,17,20
Q14,15
PULSE SEPARATOR
PULSE SEPARATOR
DC-DC CONVERTOR
RIT ENCODER INPUT
MAIN ENCODER INPUT
VCO CONTROL
VCO CONTROL SELECT
IC2
DIVIDER
500kHz
IC1
PD1
Q1–3
ACTIVE FILTER
VCO CONTROL VOLTAGE
4.5–5MHz
Q12,13 AMP
PLL1
500kHz
IC15
DIVIDER PD2 (20kHz Step) 1/490 1/739
20MHz
PLL2
IC3
MIX1
Q14 AMP
45.03–74.93MHz
VCO INPUT
Q36
OSC
20MHz
Q21 AMP
Q22–24 ACTIVE FILTER
Q15 AMP
49.93–50.42999MHz
59.93–60.42999MHz
Q34,35 AMP
VCO2
Q25
49.8–54.78MHz
BPF
IC14
MIX6
Q26 AMP
40MHz
BPF
Q16 AMP
BPF
MIX2
IC5
1/10
IC16
2MHz
BPF
10MHz
1/2
IC17
10.24MHz
Q27 AMP
DIVIDER PD3 (10kHz Step) 1/2000–1/2199
IC13
1/10
IC8
IC4
MIX3
Q18 AMP
36.1MHz
HET INPUT
13.83–14.32999MHz
Q17 AMP
1/10
IC19
Q28 AMP
Q30–32 ACTIVE FILTER
BPF
1MHz
Q40
100kHz
MARKER OUTPUT
MARKER SW
VCO3
Q29
4.98–5.478MHz
LPF
MIX4
IC6
1/218–1/235
FSK KEY INPUT
PLL3
20–21.99MHz
1/2
ACTIVE FILTER
Q33 AMP
Q20 AMP
8.85–8.85199MHz
2.2936kHz or 2.1277kHz
1/10
IC9
MCF
20–21.99kHz (10Hz STEP)
Q19 AMP
8.83MHz
1/10
IC10
1/10
IC11
LPF
MIX5
IC7
SIGNAL CAR1 INPUT

Fig. 3 PLL Block diagram and Digital control system

CIRCUIT DESCRIPTION

The 20 to 21.99kHz signal from IC11 pin 12 is mixed with the 8.83MHz CAR 1 signal to obtain the 8.85 to 8.85199 MHz signal. This signal is applied to IC5 pin 5 through MCF1, MCF2 and buffer Q20, where it is mixed with the 4.98–5.478MHz signal from PLL-2, the resultant signal varies from 13.83 to 14.32999MHz in 10Hz steps. This is applied to IC4 (MIX 3) through buffer Q17 and is mixed with the 36.1MHz HET signal to obtain a signal which varies from 49.93 to 50.42999MHz in 10Hz steps. After being buffered by Q16, the signal is applied directly to IC3 (MIX 1) pin 5 when the operating frequency is between 9.5 and 19.49999MHz. When the operating frequency is between 100kHz and 9.49999MHz, or between 19.5 and 29.99999MHz, the output signal from Q16 is applied to IC5 (MIX 2) pin 2 through switching diode D15 and is mixed with a 10MHz signal, obtained by dividing the 20MHz signal by 2. The resulting 59.93 to 60.42999MHz signal is applied to IC3 through buffer Q15. Diode switching control, is applied according to the operating frequency by the Digital unit microprocessor.

In IC3, the above signal is mixed with the VCO signal, which varies from 45.03 to 74.92999MHz, so that an output varying from 4.5MHz to 15MHz is obtained. This is applied to IC2 (divider) pin 2 through Q13 and Q12, and is divided by a value ranging from 9 to 30 to obtain a 500 kHz signal. This 500kHz signal is applied to IC1 (phase detector) pin 7. The 500kHz from IC19 pin12 is applied to IC1 pin 8 through Q4. The phases of these 500kHz signals are compared by IC1. The comparator output signal is passed through an active filter consisting of Q1, Q2 and Q3, then sent to the primary VCO in the Signal unit through the FCV terminal as the VCO control voltage, so the VCO in the Signal unit is locked within the 45.03 to 74.92999 MHz range, in 10Hz steps.

The 100kHz marker signal is obtained by dividing the 20 MHz signal by 200 by IC16 (÷ 10), IC7 (÷ 2) and IC19 (÷ 10). When the MARKER switch (CAL SW) is OFF, D20 is turned off to stop input to IC19 (1/10 divider) and Q40 is also turned off.

The FSK modulation signal is generated as follows : The 1 MHz signal obtained by dividing the 20MHz signal is output from IC17 pin 9. This is divided by 218 or 235 by IC18, then divided by 2 by IC17. The FSK modulation signal which results is output from IC17 pin 13. When the KFS terminal is open, the level at the collector of Q38 is H and the level at the collector of Q37 is L. At this time, the frequency division ratio is set to 1/218 so that a 2.2936kHz space signal is obtained. When the KFS terminal is closed, the levels at the collectors of Q38 and Q37 are reversed and the frequency division ratio is set to 1/235 so that a 2.1277 kHz mark signal is obtained.

BAND f (MHz)	1/N	PL7	PL6	PL5	PL4	PL3	PL2	PL1	PL0
0.1–0.5	N=30	1	0	1	1	0	0	0	0
0.5–1	29	1	0	1	0	1	0	0	1
1–1.5	28	1	0	1	0	1	0	0	0
1.5–2	27	1	0	1	0	0	1	1	1
2–2.5	26	1	0	1	0	0	1	1	0
2.5–3	25	1	0	1	0	0	1	0	1
3–3.5	24	1	0	1	0	0	1	0	0
3.5–4	23	1	0	1	0	0	0	1	1
4–4.5	22	1	0	1	0	0	0	1	0
4.5–5	21	1	0	1	0	0	0	0	1
5–5.5	20	1	0	1	0	0	0	0	0
5.5–6	19	1	0	0	1	1	0	0	1
6–6.5	18	1	0	0	1	1	0	0	0
6.5–7	17	1	0	0	1	0	1	1	1
7–7.5	16	1	0	0	1	0	1	1	0
7.5–8	15	1	0	0	1	0	1	0	1
8–8.5	14	1	0	0	1	0	1	0	0
8.5–9	13	1	0	0	1	0	0	1	1
9–9.5	12	1	0	0	1	0	0	1	0
9.5–10	9	0	1	0	0	1	0	0	1
10–10.5	10	0	1	0	1	0	0	0	0
10.5–11	11	0	1	0	1	0	0	0	1
11–11.5	12	0	1	0	1	0	0	1	0
11.5–12	13	0	1	0	1	0	0	1	1
12–12.5	14	0	1	0	1	0	1	0	0
12.5–13	15	0	1	0	1	0	1	0	1
13–13.5	16	0	1	0	1	0	1	1	0
13.5–14	17	0	1	0	1	0	1	1	1
14–14.5	18	0	1	0	1	1	0	0	0
14.5–15	19	0	1	0	1	1	0	0	1
15–15.5	20	0	1	1	0	0	0	0	0
15.5–16	21	0	1	1	0	0	0	0	1
16–16.5	22	0	1	1	0	0	0	1	0
16.5–17	23	0	1	1	0	0	0	1	1
17–17.5	24	0	1	1	0	0	1	0	0
17.5–18	25	0	1	1	0	0	1	0	1
18–18.5	26	0	1	1	0	0	1	1	0
18.5–19	27	0	1	1	0	0	1	1	1
19–19.5	28	0	1	1	0	1	0	0	0
19.5–20	9	0	0	0	0	1	0	0	1
20–20.5	10	0	0	0	1	0	0	0	0
20.5–21	11	0	0	0	1	0	0	0	1
21–21.5	12	0	0	0	1	0	0	1	0
21.5–22	13	0	0	0	1	0	0	1	1
22–22.5	14	0	0	0	1	0	1	0	0
22.5–23	15	0	0	0	1	0	1	0	1
23–23.5	16	0	0	0	1	0	1	1	0
23.5–24	17	0	0	0	1	0	1	1	1
24–24.5	18	0	0	0	1	1	0	0	0
24.5–25	19	0	0	0	1	1	0	0	1
25–25.5	20	0	0	1	0	0	0	0	0
25.5–26	21	0	0	1	0	0	0	0	1
26–26.5	22	0	0	1	0	0	0	1	0
26.5–27	23	0	0	1	0	0	0	1	1
27–27.5	24	0	0	1	0	0	1	0	0
27.5–28	25	0	0	1	0	0	1	0	1
28–28.5	26	0	0	1	0	0	1	1	0
28.5–29	27	0	0	1	0	0	1	1	1
29–29.5	28	0	0	1	0	1	0	0	0
29.5–30	29	0	0	1	0	1	0	0	1

Table 2 PLL data

CIRCUIT DESCRIPTION

DIGITAL CIRCUIT

Fig. 3 shows a block diagram of the Digital unit, which consists of 31 ICs including a custom CPU, µPD8049C-211 (IC6). The CPU uses a mapped I/O system on a common bus to control many signals. I/O signals are latched by IC25–29 to prevent noise from affecting other circuits. There are two encoder input ports ; one for the main tuning control signal and the other for the RIT control signal. Each encoded input is applied to a logic circuit that determines both direction of rotation also sends information to the CPU to indicate the desired frequency change. The output of IC16 pin 3 or 4 determines the direction of rotation of the Main encoder. For example, when the encoder is rotated, the output at pin 4 goes to +5V. This output level is maintained until rotation is stopped. The output then returns to 0V. If the dial is turned in the opposite direction, the output drops to –5V and is maintained until rotation is again stopped. Internal variations in IC16 itself determine which pin (3 or 4) must be connected for proper action of the main tuning dial.

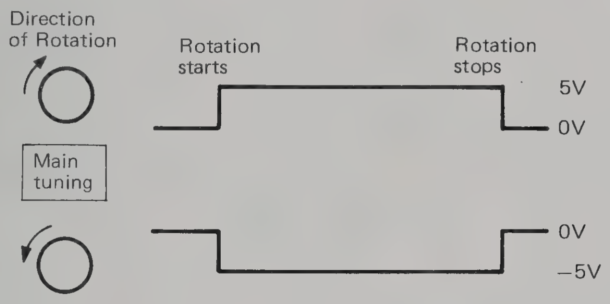


Fig. 4

The RIT rotary encoder operation is similar, but the output of IC19 pin 3 will always be as in Fig. 4, above.

Desired frequency change is sent to the CPU via D13, 14 for the Main encoder and via D18, 19 for the RIT encoder. This output data is in the form of data pulses and is at a rate of 4 pulses per encoder disk opening. For example, If the Main encoder is rotated so 10 slots are sensed, 40 pulses will be sent to the CPU. Tuning rate is 10 kHz per revolution in 10 Hz steps. When the rotational speed of the main tuning knob exceeds 5–6 rev/sec, the step size is automatically increased in geometric progression. In other words the faster the knob is rotated, the greater the step becomes. The RIT control covers ±9.99 kHz.

IC13 (µPD5101LC) is a C-MOS RAM which stores frequency data for the 8 memory channels, and VFOs A and B. IC13 back-up power is supplied by three 1.5V AA batteries, through diode D10, when the power switch is OFF. Since the required back-up current is only 10µA, memories will be maintained for approximately 24hr, even if no batteries are installed, by the discharge current of C21. Power is supplied to IC13 through Q23 and Q24 when the power switch is ON.

IC1 through IC4 are display drivers. Display date is multiplexed from the microprocessor. Connectors 13 through 16 output to the display tube. Terminals a through g and DP are 7 segment and decimal point data for the display. Terminals P1 through P10 are signals for the analog-type display, which approximates a conventional dial pointer. Terminals G1 through G10 are display tube grid signals. Heater voltage at approximately 7 Vpp is generated by DC-DC converter Q14 and Q15 and is supplied to the display tube terminals FH and FG. Q16 is a switching transistor used to blank the display tube if the PLL unlocks. IC21 through IC24 are multiplexers. Whenever the collector of Q25 is "L" low, data from the inputs of IC21–24 (pins D0–D6) is distributed to the appropriate IC. Input data selection is by means of control signal from IC12 the address latch (pins Q1, Q2 and Q3). If the collector of Q25 is held "H" no data transfer can occur.

IC11 and IC12 form an 8-bit address latch and IC25 through IC29 are output data latches : IC25 and IC26 latch 8-bit frequency division data which is sent to the PLL unit (PLL-1) through terminals PL0 through PL7. IC27 and part of IC28 latch the band data which is sent to the Antenna Tuner through terminals AT0 through AT4. The remainder of IC28 latches the band data which is sent to the Low Pass Filter unit through LP0 through LP2. IC29 latches the band data sent to the RX BPF in the Signal unit through terminals RB0 through RB3.

By two gates of IC7, Serial frequency division data is output-gated and is sent to PLL-2 and PLL-3 in the PLL unit via terminals PLL2 and PLL1.

Q20, Q21 and Q22 form a reset circuit. If the voltage at the 5V line accidentally drops, Q21 is turned on and its collector level becomes "H". This turns Q22 on and a "L" pulse is generated at its collector. This pulse signal is applied to the CE terminal IC13 pin 17 to disable read-write functions so that its contents are protected. Simultaneously, Q20 base becomes "H" and Q20 turns on. Therefore the logic "L" at Q20 collector is felt at IC6 pin 4 and the CPU is reset.

Tables 3 through 5 and Fig. 5 show various data input to and output from the Digital unit.

CIRCUIT DESCRIPTION

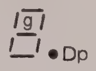
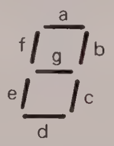
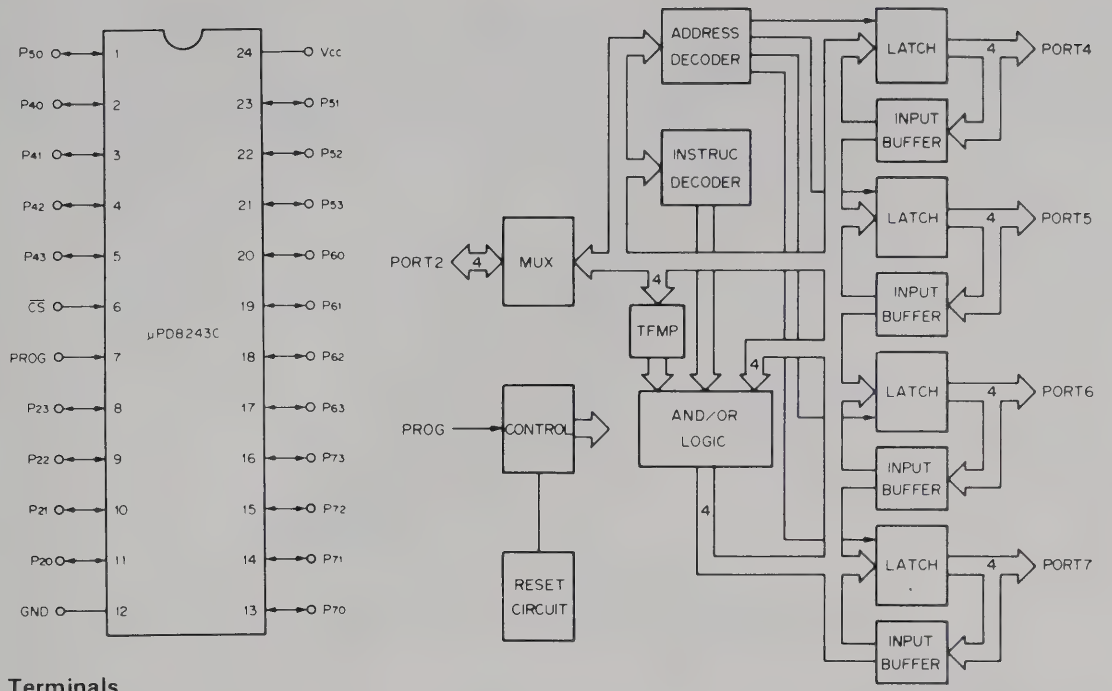
Terminals			Functions
No.		Name	
①	1	24I	DC-DC converter input approx. 24V.
	2	12I	AVR input.
	3	5I	AVR input.
②	1	BZ	Signal unit tone oscillator on when "L".
	2	BRK	When the Main knob is turned, a L pulse is output for the NB gate at every 2kHz step.
	3	UL	PLL unlock input, L : unlock, display blanks.
	4	TS	"L" pluse is output when changing BAND, TX stops when "L".
	5	−C	Approx. −43V.
	6	TR	TX and RX switching signal input, "L" in RX, "H" in TX.
③	1	G	GND
	2	BAT	Back up DC input 1.5V x 3.
④	1	5V	5V DC.
	2	ME2	Main encoder input, 90° phase difference, 50% duty cycle.
	3	ME1	
	4	G	GND
⑤	1	5V	5V DC.
	2	RE2	RIT encoder input, 90° phase difference, 50% duty cycle.
	3	RE1	
	4	G	GND
⑥	1	DM	Dimmer at open, normally GND.
	2	—	Not used.
	3	M0	Memory channel M0.
	4	CLR	Normally "H", RIT f is cleared when "L".
	5	B0	BAND DATA input B0.
	6	FR	VFO select on RX, VFO B at "H", VFO A at "L".
	7	RIT	Normally "H", RIT-ON, OFF state changes at "L".
	8	BD	1MHz step BAND DATA, f descends 1MHz steps in at "L".
	9	—	Not used.
	10	B1	BAND DATA input B1.
	11	AB	VFO A=B switch, VFO A=B when "L".
	12	M1	Memory CH M1.
⑦	1	LOCK	Main dial f is locked when "L".
	2	MV	Memory and VFO select, VFO at "H", Memory at "L".
	3	BU	1MHz step BAND UP DATA input, frequency ascends in 1MHz steps when "L" is input.
	4	MD	MIC DOWN input, "L" : DOWN.
	5	—	Not used.
	6	B3	BAND DATA B3.
	7	MR	Memory recall at "L".
⑧	1	—	Not used.
	2	MU	MIC UP input, "L" : UP.
	3	—	Not used.
	4	M2	Memory CH M2.
	5	MIN	Memory in at "L".
	6	FSK	"H" at FSK mode, increases ref. f 2.29kHz.
	7	B2	BAND DATA B2.
	8	FT	VFO select in transmit, VFO B at "H", VFO A at "L".
⑨	1	12V	12V DC to PLL unit.
	2	UL	Unlock signal at "L" from PLL unit.
	3	PL3	PLL DATA for 500kHz comparison.
	4	PL2	
	5	PL4	
	6	PL1	
	7	PL0	
⑩	1	PL6	PLL DATA for 500kHz comparison.
	2	PL7	
	3	PL5	
⑪	1	AT1	BAND DATA to ANT tuner.
	2	AT2	
	3	AT3	
	4	AT4	
	5	AT0	
	6	LP2	BAND DATA in transmit to the Filter unit.
	7	LP0	
	8	LP1	
	9	RB3	BAND DATA in receive to the Signal unit.
	10	RB2	
	11	RB0	
	12	RB1	
⑫	1	G	GND
	2	PLL1	Serial division data for PLL1 10Hz steps.
	3	G	GND
	4	CK	Clock signal.
	5	G	GND
	6	PLL2	Serial division data for PLL2 2kHz steps.
	7	G	GND
	8	EN	Division data store signal for PLL IC, data is shifted at "H".
⑬	1	—	Not used.
	2	VFO A	Indicator.
	3	ON	
	4	LOCK	
	5	P2	DATA for analog digit.
	6	P3	
	7	P4	
	8	P1	
	9	P9	
	10	P10	
⑭	1	g	
	2	DP	Dot "•" 
	3	P5	DATA for analog digit.
	4	P6	
	5	P7	
	6	P8	
	7	SK	
	8	G1	GRID DATA.
	9	G2	
	10	G3	
	11	G4	
⑮	1	G5	GRID DATA.
	2	G6	
	3	G7	
	4	G8	
	5	G9	
	6	G10	
	7	FH	Heater for Display tube.
	8	FG	
⑯	1	b	
	2	c	
	3	d	
	4	a	
	5	e	
	6	f	
	7	MEMO	MEMO indicator.
	8	VFO B	VFO B indicator.

Table 3 Digital unit terminal function

CIRCUIT DESCRIPTION


P50 1
P40 2
P41 3
P42 4
P43 5
CS 6
PROG 7
P23 8
P22 9
P21 10
P20 11
GND 12
24 Vcc
23 P51
22 P52
21 P53
20 P60
19 P61
18 P62
17 P63
16 P73
15 P72
14 P71
13 P70
μPD8243C
ADDRESS DECODER
INSTRUC DECODER
PORT2
4
MUX
TEMP
AND/OR LOGIC
PROG
CONTROL
RESET CIRCUIT
LATCH
INPUT BUFFER
PORT4
PORT5
PORT6
PORT7

Terminals

$P_{20} \sim P_{23}$	: Input Output (Port 2)
$P_{40} \sim P_{43}$	: Input Output port (Port 4)
$P_{50} \sim P_{53}$	: Input Output port (Port 5)
$P_{60} \sim P_{63}$	: Input Output port (Port 6)
$P_{70} \sim P_{73}$	: Input Output port (Port 7)
$\overline{CS}$	: Chip Select
PROG	: Program pulse Input Output port (Port 2)

Maximum Rating (Ta = 25°C)

Item	Symbol	Rating
Operating voltage	Vcc	−0.5 ~ +7V
Input voltage	Vi	−0.5 ~ +7V
Output voltage	Vo	−0.5 ~ +7V
Operating temperature	Topt	0 ~ +70°C
Storage temperature	Tstg	−60 ~ +150°C

Fig. 5 μPD8243C (Digital unit IC5)

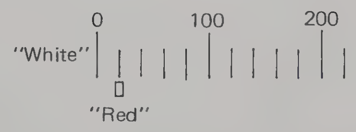
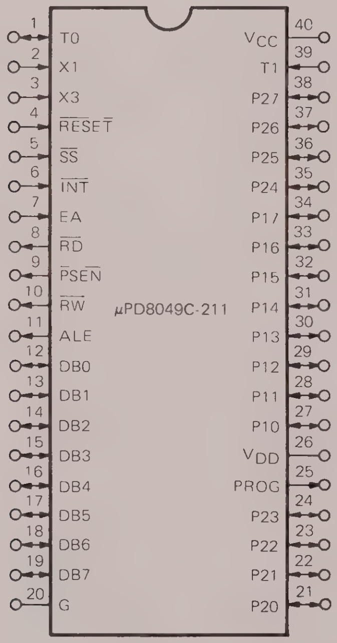
Pin No.	Name	Functions		
13	P70	G2 Digit output		
14	P71	G1		
15	P72	H	H Scale DATA output	L
16	P73	H	L	H
2	P40	e	P9	VFO B
3	P41	f	P10	MEMO
4	P42	g		
5	P43	Dp Segment DATA	Scale DATA	
1	P50	a	P1	(−)
23	P51	b	P2  0 100 200 "White" "Red"	LOCK
22	P52	c	P3	RIT
21	P53	d	P4	VFO A
20	P60		P5	
19	P61		P6	
18	P62		P7	
17	P63		P8	

Table 4

CIRCUIT DESCRIPTION

Terminals		Functions	Terminals		Functions
No.	Name		No.	Name	
1	T0	RIT encoder clock signal, count at "L".	21	P20	I/O Expander control output.
2	X1	Xtal input	22	P21	
3	X3		23	P22	
4	—		24	P23	
5	$\overline{\text{SS}}$	Single step.	25	PROG	
6	$\overline{\text{INT}}$	Interrupt.	26	V_{DD}	5V
7	EA	External access. Nomally GND.	27	P10	Digit output.
8	$\overline{\text{RD}}$	Read	28	P11	
9	—		29	P12	
10	$\overline{\text{RW}}$	Read/Write	30	P13	
11	ALE	Address latch enable.	31	P14	
12	DB0	External Data bus.	32	P15	
13	DB1		33	P16	
14	DB2		34	P17	
15	DB3		35	P24	Enable data for PLL.
16	DB4		36	P25	Tone output.
17	DB5		37	P26	Blanking output.
18	DB6		38	P27	TX-stop signal output.
19	DB7		39	T1	Main encoder clock signal, count at "L".
20	G	GND	40	V_{CC}	5V

Table 5 Functions of μPD8049C-211 (Digital unit IC6)


μPD8049C-211
1 T0
2 X1
3 X3
4 RESET
5 SS
6 INT
7 EA
8 RD
9 PSEN
10 RW
11 ALE
12 DB0
13 DB1
14 DB2
15 DB3
16 DB4
17 DB5
18 DB6
19 DB7
20 G
40 VCC
39 T1
38 P27
37 P26
36 P25
35 P24
34 P17
33 P16
32 P15
31 P14
30 P13
29 P12
28 P11
27 P10
26 VDD
25 PROG
24 P23
23 P22
22 P21
21 P20

ACCESSORY CIRCUITS

- **Noise blanker in the Signal unit**

Fig. 6, 7 shows the noise blanker. The noise blanker consists of two circuits, NB1 and NB2. Noise sampled from the RX 2nd mixer (Q62 and Q63) output transformer is amplified approximately 70dB by Q28 to Q30 and Q32. The amplified noise signal is applied to both NB1 and NB2 circuits. In NB1, the noise is buffered by Q33 and detected by D52 and D53. The detector output is applied to switching transistor Q35. In NB2, the noise is applied directly to the noise detector circuit consisting of D54 to D56 and Q36. NB1 detects pulse noise included in the input signal and switches the noise blanking gate consisting of D82 and D84 to D86, which is located before the RX 2nd IF filter, XF1. The NB1 system is a conventional noise blanker. Noise detected by D54 to D56 and Q36 is shaped by IC2 so that only high level pulse noise components are extracted in the form of a square wave. This square wave is applied to both the switching transistor Q38, to control the 3rd RX mixer (Q65 and Q66), and to the NB gate through D57 and Q31 to switch the gate. The NB2 system is effective against radar-type pulse noise, commonly called "the woodpecker". The noise blankers are also used to reduce clicks generated by the digital VFO step reset pulse.

CIRCUIT DESCRIPTION

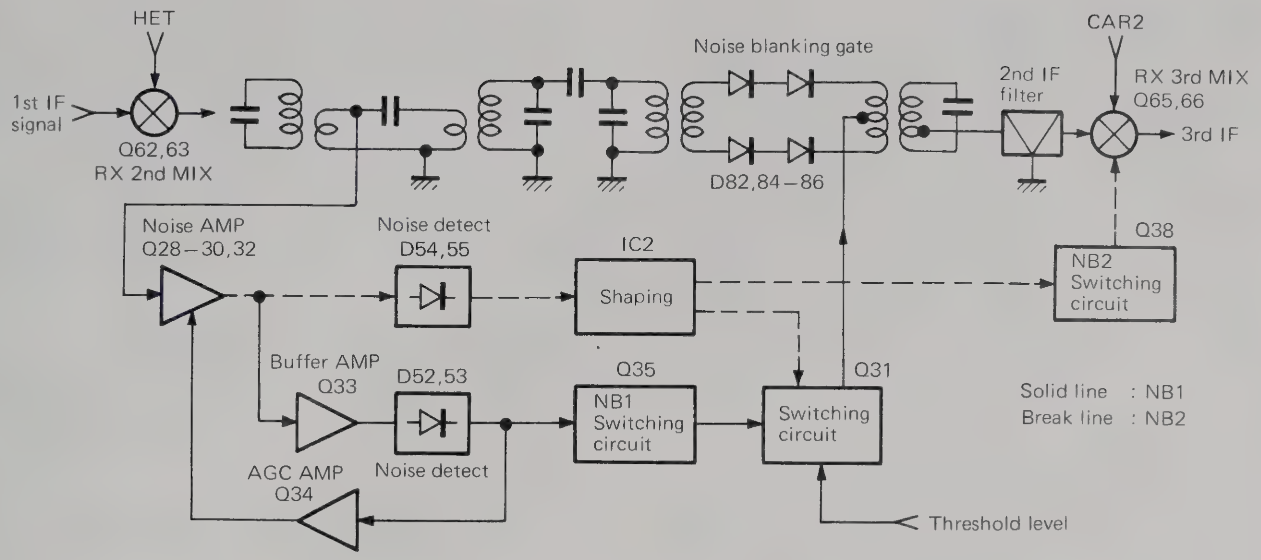

HET
1st IF signal
Q62,63
RX 2nd MIX
Noise blanking gate
D82,84–86
2nd IF filter
CAR2
RX 3rd MIX
Q65,66
3rd IF
Noise AMP
Q28–30,32
Noise detect
D54,55
IC2
Shaping
Q38
NB2 Switching circuit
Buffer AMP
Q33
D52,53
Q35
NB1 Switching circuit
Q31
Switching circuit
Solid line : NB1
Break line : NB2
AGC AMP
Q34
Noise detect
Threshold level

Fig. 6 Noise blanker circuit

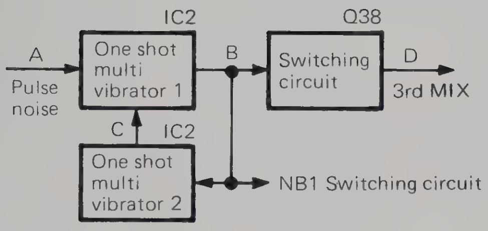

IC2
Q38
A
Pulse noise
One shot multi vibrator 1
B
Switching circuit
D
3rd MIX
C
IC2
One shot multi vibrator 2
NB1 Switching circuit

Fig. 7 NB2 circuit

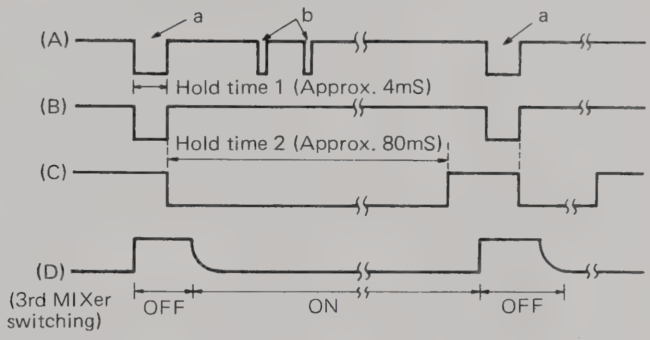


Fig. 8 NB2 timing chart

● Speech processor in the Signal unit

A block diagram of the speech processor is shown in Fig. 9. An SSB signal, having passed 455kHz filter CF1 and buffer Q72, is amplified by Q71 and applied both to the detector consisting of D116 and D117, and to limiting amplifier IC6. The detected signal is applied to DC amplifiers Q73 and Q74, where it is logarithmicly compressed, and is then applied to the multi-meter to indicate compression level. The output level of IC6 is constant regardless of input level. The output signal is applied to gain control amplifier Q70, then input to the TX 1st mixer. When the processor is off, it is bypassed through switching diodes D118 and D114. In the FSK mode, the signal is automatically compressed approximately 10dB (even if the processor switch is off) to equalize any variations in level between mark and space signals. In the FSK mode, the transmission power and ALC are adjusted with the PROC-OUT control.

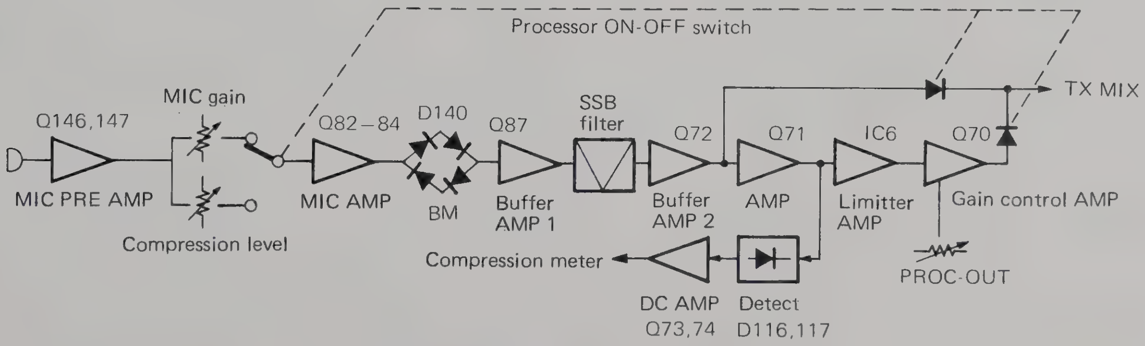

Processor ON-OFF switch
TX MIX
MIC gain
Q146,147
MIC PRE AMP
Compression level
Q82–84
MIC AMP
D140
BM
Q87
Buffer AMP 1
SSB filter
Q72
Buffer AMP 2
Q71
AMP
IC6
Limitter AMP
Q70
Gain control AMP
PROC-OUT
Compression meter
DC AMP
Q73,74
Detect
D116,117

Fig. 9 Speech processor block diagram

CIRCUIT DESCRIPTION

● Monitor circuit in the Signal unit

The SSB signal is sampled from the drain of TX 2nd IF amplifier Q57, is amplified by Q58 and Q125, and then applied to the product detector Q126. The detected AF signal is amplified by Q127, and applied to AF power amplifier IC3.

● Side tone circuit in the Signal unit

The 100 kHz CAR 3 signal and 99.2 kHz CAR 4 signal are applied to the product detector D238 to D241 to obtain an 800 Hz signal. This 800 Hz signal is applied to AF power amplifier IC3. Q152 is switched on by the STK line through D233, and side tone is generated when the key is closed. This side tone circuit makes it possible to vary the incoming CW pitch. Signals can be zero-beat by making the side tone pitch the same as that of the CW signal being received.

● SWR calculation circuit in the Signal unit

Conventional SWR indicators require sensitivity adjustment for the forward wave level. The SWR metering circuit incorporated in the TS-930S makes this adjustment automatically. This new SWR calculation circuit is shown in Fig. 10. Forward wave voltage VSF and reflected wave voltage VSR sampled from the Filter unit are applied to the analog calculation circuit in the Signal unit. IC4 is a V-I converter for the (optional) AT-930 auto antenna tuner. Output from IC4 pin 1, proportional to VSR/VSF, drives the SWR meter. IC4 also includes an integrator, IC5 is a voltage comparator, and a triangular wave generator and Q53 and Q54 are switching transistors.

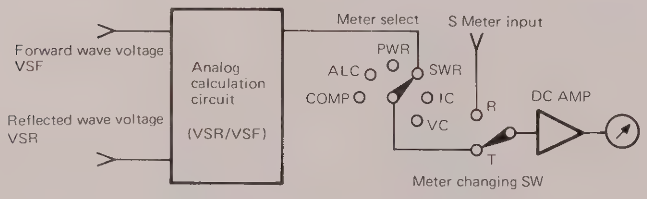


Fig. 10 SWR meter circuit

The VSF voltage is compared with a 0.5V REF voltage on IC4 pin 12. If VSF decreases (i.e. SWR increases) the voltage level at pin 14 increases. The output of IC5 pin 1 is a triangular reference signal and is mixed with the voltage from IC4 pin 14. Changes in the output of IC4 pin 14 affect the reference level of this triangular wave. IC5 computes the change and sends a square wave signal, whose pulse width and spacing are proportional to the change, to control conduction of switching transistors Q53, Q54. See Fig. 11.

The voltage at IC4 pin 1 is a level proportional to VSR/VSF, and is used to drive the SWR meter and also for AT-930 control purposes. VR16 ia an SWR meter adjust for initial setup only.

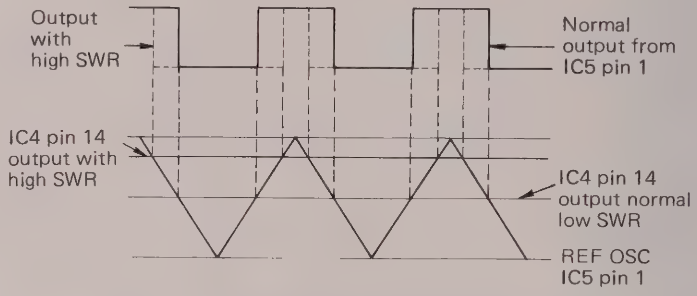


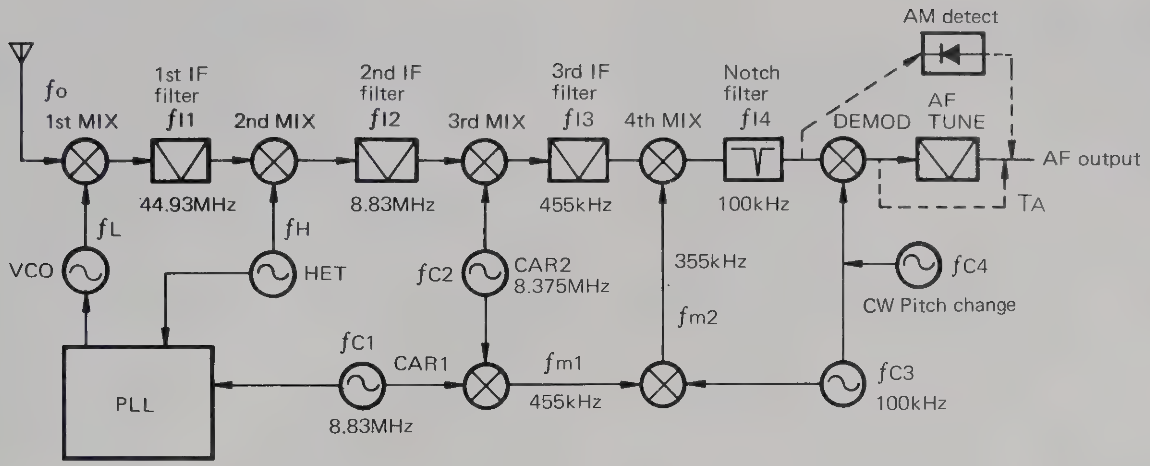
Fig. 11 Automatic SWR computing circuit waveforms

● CW-VBT (variable bandwidth tuning) and SSB-slope-tune in the Signal unit

Fig. 12 shows the CW-VBT and SSB-slope-tune circuits. The principle of CW-VBT operation will be explained first. When CAR 1 and CAR 2 are at their normal frequencies, the overall IF response is indicated by "A". When the CAR 1 frequency is shifted by Δf1, the overall IF response curve shifts to that at "B". The circuit is designed so the CAR 1 signal lowers the VCO frequency fL by Δf1. In this case, the IF bandwidth is fully opened, or normal. Whe the CAR 2 frequency is lowered by Δf2, the 3rd IF filter frequency response curve shifts to that indicated by "C". Thus, the overall IF bandwidth is narrowed. The TS-930S VBT function is designed to operate as : Δf2 = 2Δf1. The overall IF bandwidth is narrowed by varying the CAR 1 and CAR 2 frequencies without shifting the overall IF response center frequency.

Next, the SSB-slope-tune function will be explained. When the circuit is designed so that variations in the CAR 1 and CAR 2 frequencies have the relationship Δf1 = Δf2, only the lower frequency (at the left limit of the overall IF reaponse curve, shown in Fig. 13) can be shifted by varying these frequencies. The higher frequency (at the right limit) can be shifted by varying just the CAR 2 frequency. In the TS-930S, these two operations are performed by separate controls. The CAR 1 frequency control voltage VF1 and CAR 2 control voltege VF2 are supplied from the Switch unit.

CIRCUIT DESCRIPTION


AM detect
f_O
1st MIX
1st IF filter
f_{I1}
2nd MIX
2nd IF filter
f_{I2}
3rd MIX
3rd IF filter
f_{I3}
4th MIX
Notch filter
f_{I4}
DEMOD
AF TUNE
AF output
TA
44.93MHz
8.83MHz
455kHz
100kHz
f_L
f_H
VCO
HET
f_{C2}
CAR2
8.375MHz
355kHz
f_{m2}
f_{C4}
CW Pitch change
f_{C1}
CAR1
f_{m1}
PLL
8.83MHz
455kHz
f_{C3}
100kHz

$$\begin{cases} f_L = f_H + f_{C1} + f_R \\ f_{m2} = f_{C1} - f_{C2} - f_{C3} \\ f_{C4} = f_{C3} - \Delta f_P \end{cases}$$

f_R : Dial displayed frequency

f_O : CAR frequency (SSB,AM,CW)

∴ Tuning point : $f_R = f_O$

$$\begin{cases} f_{I1} = f_L - f_O & \to \text{: Tuning time} \\ f_{I2} = f_{I1} - f_H = f_R - f_O + f_{C1} \to f_{C1} \\ f_{I3} = f_{I2} - f_{C2} = f_R - f_O + f_{C1} - f_{C2} \to f_{C1} - f_{C2} \\ f_{I4} = f_{I3} - f_{m2} = f_R - f_O + f_{C3} \to f_{C3} \\ f_A = |f_{I4} - f_{C3}| = |f_R - f_O| \to 0 \text{ ; SSB,FSK,TUN} \\ f_A = |f_{I4} - f_{C4}| = \Delta f_P \to \text{CW} \end{cases}$$

Fig. 12-A RX configuration Normal (wide) response

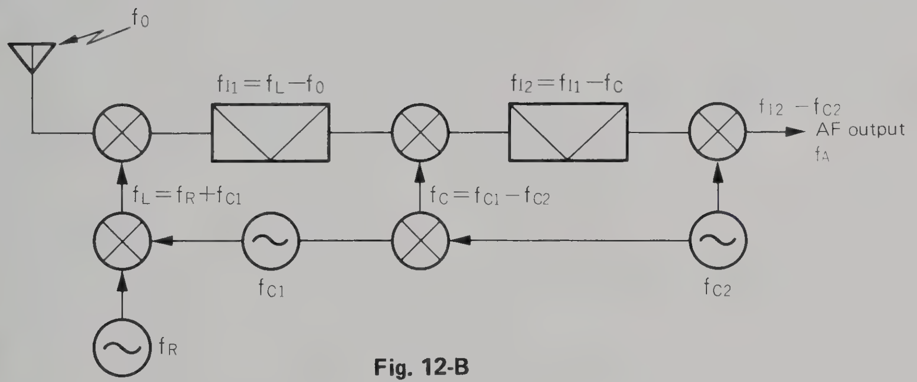

f_0
$f_{I1} = f_L - f_0$
$f_{I2} = f_{I1} - f_C$
$f_{I2} - f_{C2}$
AF output
f_A
$f_L = f_R + f_{C1}$
$f_C = f_{C1} - f_{C2}$
f_{C1}
f_{C2}
f_R

Fig. 12-B

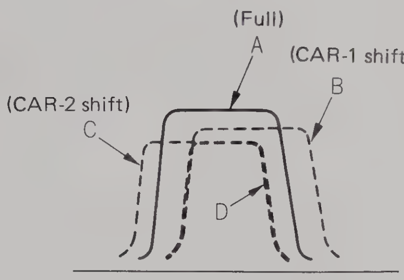

(Full)
A
(CAR-1 shift)
B
(CAR-2 shift)
C
D

Fig. 12-C CAR-2 shifted

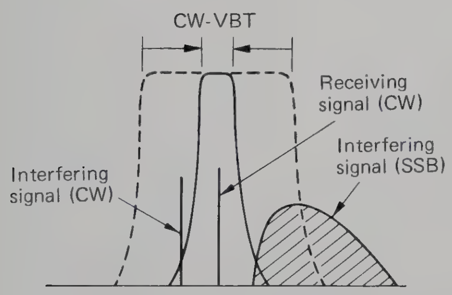

CW-VBT
Receiving signal (CW)
Interfering signal (SSB)
Interfering signal (CW)

Fig. 12-D CW-VBT

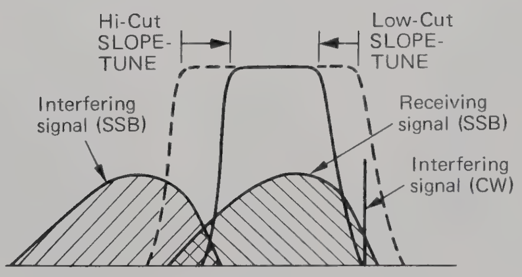

Hi-Cut SLOPE-TUNE
Low-Cut SLOPE-TUNE
Interfering signal (SSB)
Receiving signal (SSB)
Interfering signal (CW)

Fig. 12-E SSB-slope-tune

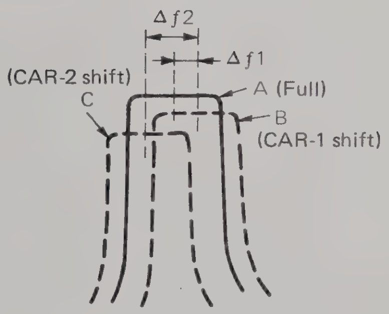

$\Delta f2$
$\Delta f1$
(CAR-2 shift)
C
A (Full)
B
(CAR-1 shift)

Fig. 13 VCO to bandwidth relationship

CIRCUIT DESCRIPTION

● Notch filter in the Signal unit

The notch filter is a bridged-T filter consisting of L, C and R components. It is located between the 4th RX mixer and the 100kHz IF amplifier Q130. The filter resonant frequency is shifted by varying the voltage applied to the cathode of vari-cap diode D217. The filter operates in all modes.

● AF-tune in the Signal unit

The AF-tune circuit is three-pole active filter built around IC7, located between the SSB/CW detector and AF amplifier Q160. AF-tune is available only in the CW mode. The tuning range is 800Hz ± 400Hz, or greater. When the AF-tune circuit is switched off, the circuit is bypassed through D248.

● VOX and ANTI-VOX circuits in the Signal unit

Fig. 14 shows the VOX and ANTI-VOX circuits. The signal output by MIC preamplifier Q146 is applied to VOX amplifier Q145 through the VOX gain control. The AF output, sampled from the speaker line, is applied to the ANTI-VOX amplifiers Q149 and Q148. An adjustable DC bias voltage is applied to the base of Q148 to control the ANTI-VOX operating level. The digital signals output from these amplifiers are applied to the RS flip-flop IC10. The signal which is first input to the flip-flop has priority. Output from the flip-flop is applied to one-shot multivibrator IC9, and its output is applied to time constant circuit C449 and R567, which determines the VOX delay. This circuit configuration affords fast VOX rise time, and prevents VOX "chatter".

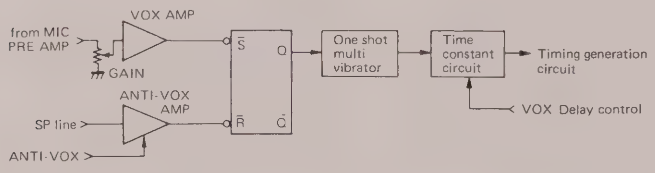

VOX AMP
from MIC PRE AMP
GAIN
ANTI-VOX AMP
SP line
ANTI-VOX
S̄
Q
R̄
Q̄
One shot multi vibrator
Time constant circuit
Timing generation circuit
VOX Delay control

Fig. 14 VOX, ANTI-VOX circuit configuration

● Final cooling fan control circuit in the Filter unit

The final heat sink temperature is detected through thermistor TH1 on the Final unit. When the temperature reaches approximately 50°C, a Schmitt circuit, consisting of Q16 and Q17, operates to turn Q22 on. Then, approximately 10V is supplied to the fan motor through the MOT terminal, as Zener D12 is cut off by D10 and Q19. This Schmitt circuit is designed to shut off when the temperature drops to about 45°C.

● Temperature protection circuit in the Filter unit

This circuit also uses the signal from thermistor TH1 on the Final unit. When the final heat sink temperature reaches approximately 75 – 80°C, another Schmitt circuit, consisting of Q18 and Q19, operates. The collector of Q19 goes H, Q23 is turned on and D10 is cut off. Therefore, the voltages of both Zener diodes D11 and D12 are added ; 13V is now applied to the fan motor through the MOT terminal. Thus, the fan motor speeds-up to cool the heat sink rapidly. Simultaneously, the H logic level at Q19 collector is sent to the Signal unit through the THP terminal to switch the transceiver from transmission to reception. This circuit is reset and transmission is re-enabled when the temperature drops below 65 – 70°C (nominal). After reset, the fan continues to operate until the final heat sink temperature drops below about 45°C. (See Fig. 15.)

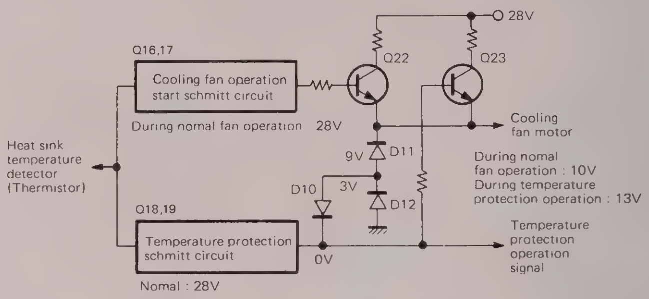

28V
Q16,17
Q22
Q23
Cooling fan operation start schmitt circuit
During nomal fan operation 28V
Cooling fan motor
Heat sink temperature detector (Thermistor)
9V
D11
D10
3V
D12
During nomal fan operation : 10V
During temperature protection operation : 13V
Q18,19
Temperature protection schmitt circuit
0V
Temperature protection operation signal
Nomal : 28V

Fig. 15 Fan, temperature protection (Final amps)

● Power supply cooling fan control circuit in the Power supply unit

This circuit monitors the power supply heat sink temperature through thermistor TH1. Its operation is similar to the Final unit fan control circuit, previously discussed. It turns the fan on when the power supply heat sink temperature reaches about 60°C and turns off when the temperature drops below about 50°C.

● CW full break-in timing circuit in the Signal unit

Fig. 16 is the timing chart for CW full break-in and send-receive switching in the SSB, FSK and TUNE modes. The TS-930S uses TV, RV, TR, TBK and ALC as timing signals for T-R switching. TV and RV are the power supply voltages for the send and receive systems. About 3ms of quiscent time is provided for both TV and RV at each send-receive switching transition. The operating state is passed to the PLL unit by the TR signal for frequency control during RIT or split frequency operation. TV goes "L" about 6ms after TBK goes "L". During this 6ms period, the TX RF power drops together with the ALC voltage. TB is the bias voltage for the send system and RB is that for the receive system. TB and TV are switched simultaneously. RB is on when TB is off, and vice versa. Fig. 17 shows the timing for CW semi-break-in and for CW keying after the standby switch has been placed to SEND. Note : Omitted signals (such as RV and TR) are the same as shown in Fig. 16.

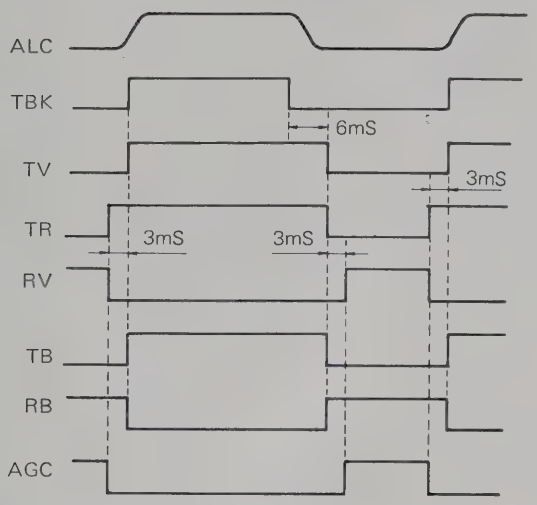
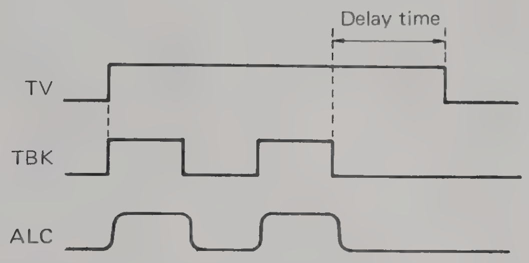
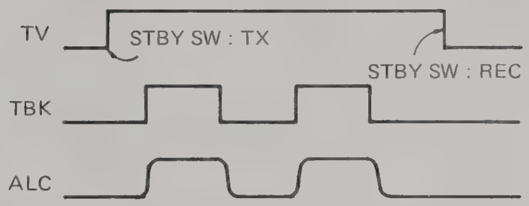


Fig. 16 T-R timing chart (CW full break-in, SSB, FSK and TUNE modes)



Semi-break-in



CW keying when SEND SW is ON

Fig. 17 CW operation timing chart

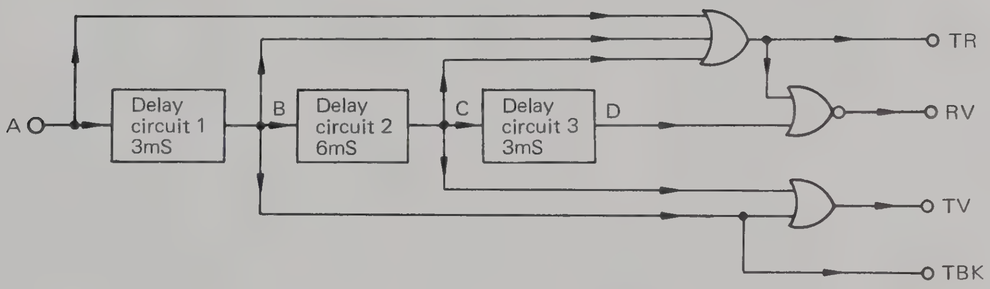

A
Delay circuit 1 3mS
B
Delay circuit 2 6mS
C
Delay circuit 3 3mS
D
TR
RV
TV
TBK

Fig. 18 Timing circuit block diagram

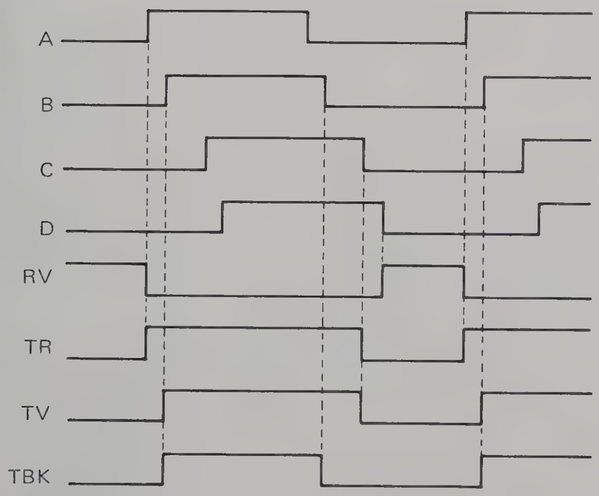


Fig. 19

REFERENCE DATA

SSB, VOX

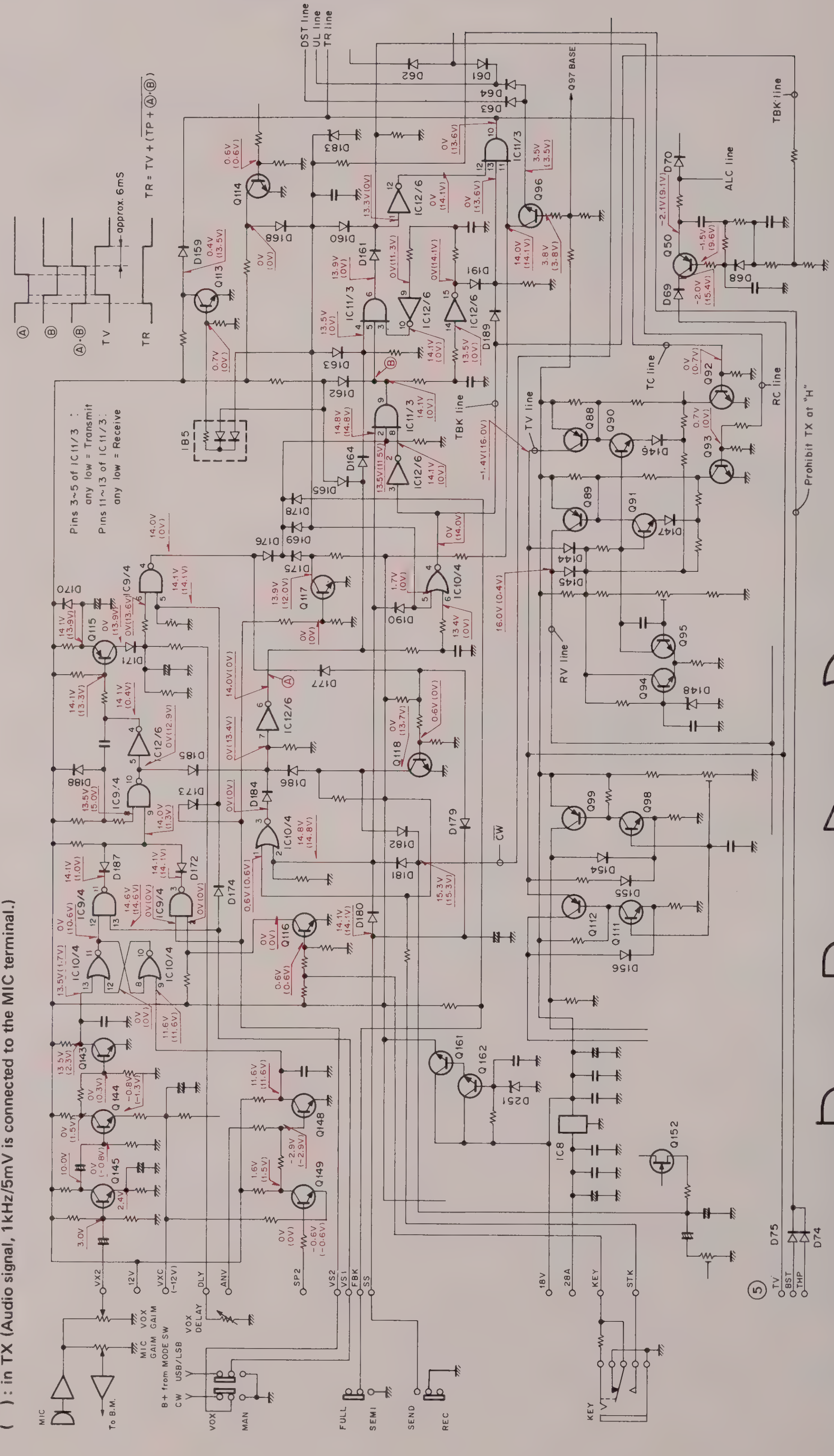
Voltage measurement conditions

f = 14.175.0MHz MODE : SSB VOX/MAN : VOX MIC CONTROL : Centered

VOX GAIN : Centered STBY : REC MIC INPUT : 1kHz/5mV

( ) : in TX (Audio signal, 1kHz/5mV is connected to the MIC terminal.)

Note: In SSB and with the standby switch in the "SEND" position, a low is felt then D179 to turn off Q118. This applies a "H" to IC12/6 pin No.7. IC10/4 is not used when the "SEND" switch is.



MIC
To B.M.
MIC GAIM
VOX GAIM
B+ from MODE SW
USB/LSB
CW
VOX DELAY
VOX
MAN
FULL
SEMI
SEND
REC
KEY
VX2
12V
VXC (−12V)
DLY
ANV
SP2
VS2
VS1
FBK
SS
18V
28A
KEY
STK
⑤
TV
BST
THP
D75
D74
DST line
UL line
TR line
Q97 BASE
TBK line
ALC line
TC line
RC line
TV line
RV line
TBK line
Prohibit TX at "H"
CW
Pins 3~5 of IC11/3 : any low = Transmit
Pins 11~13 of IC11/3 : any low = Receive
approx. 6mS
Ⓐ
Ⓑ
Ⓐ·Ⓑ
TV
TR
TR = TV + (TP + Ⓐ·Ⓑ)
IB5
IC8
IC9/4
IC10/4
IC11/3
IC12/6
Q50
Q88
Q89
Q90
Q91
Q92
Q93
Q94
Q95
Q96
Q98
Q99
Q111
Q112
Q113
Q114
Q115
Q116
Q117
Q118
Q143
Q144
Q145
Q148
Q149
Q152
Q161
Q162
AND gate
NAND gate
NOT gate
NOR gate

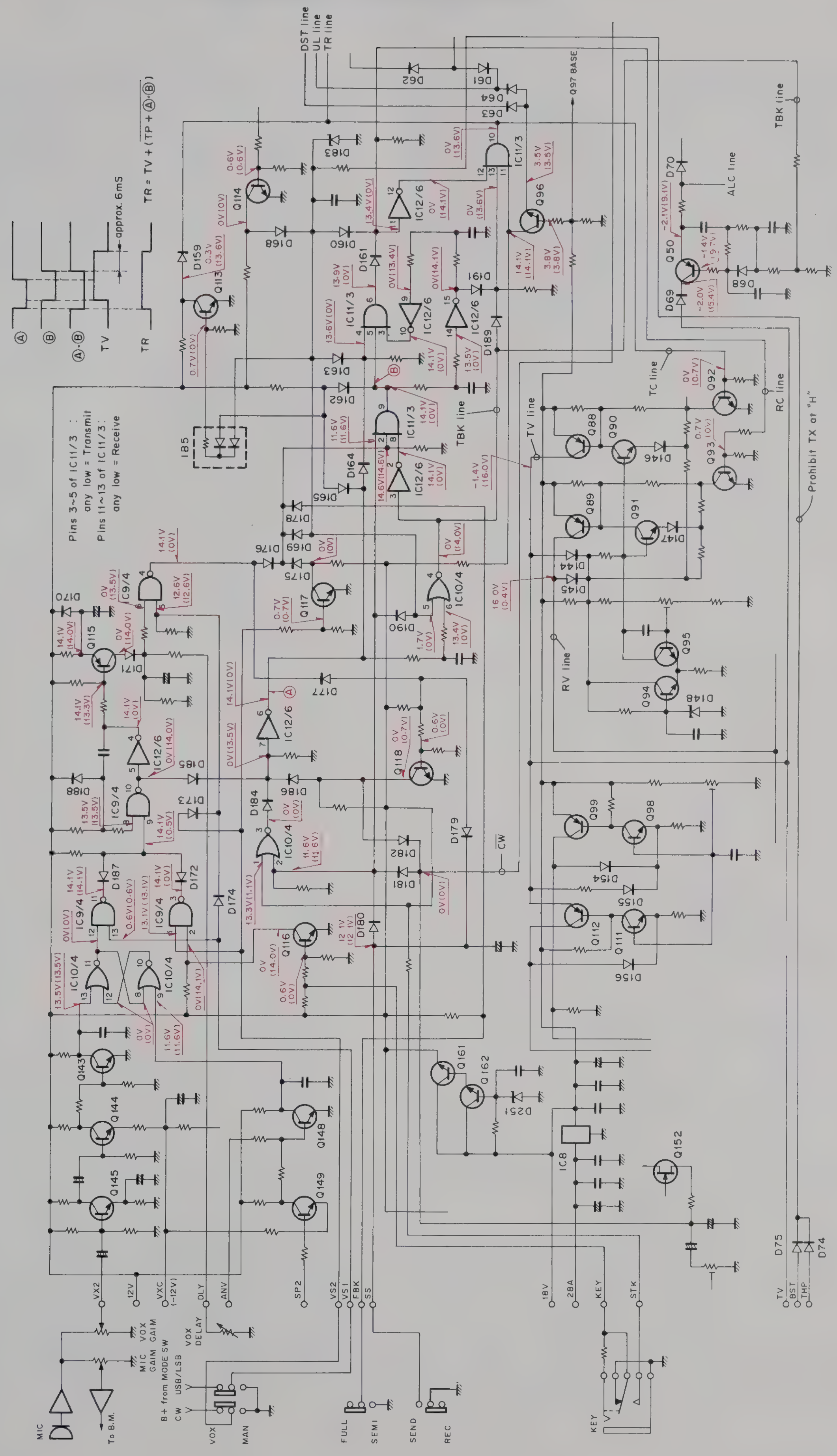
REFERENCE DATA

CW FULL BRAKE IN

Voltage measurement conditions

f = 14.175.0MHz MODE : CW VOX/MAN : VOX FULL/SEMI : FULL CAR CONTROL : MIN STBY : REC

KEY OPEN (in RX) ( ) : KEY CLOSED (in TX)



Ⓐ
Ⓑ
Ⓐ·Ⓑ
TV
TR
approx. 6mS
TR = TV + (TP + Ⓐ·Ⓑ)
Pins 3~5 of IC11/3 : any low = Transmit
Pins 11~13 of IC11/3 : any low = Receive
DST line
UL line
TR line
Q97 BASE
TBK line
ALC line
TC line
TV line
TBK line
RC line
RV line
Prohibit TX at "H"
MIC
To B.M.
MIC GAIM
VOX GAIM
B+ from MODE SW
USB/LSB
CW
VOX DELAY
VOX
MAN
FULL
SEMI
SEND
REC
KEY
VX2
12V
VXC (−12V)
DLY
ANV
SP2
VS2
VS1
FBK
SS
18V
28A
KEY
STK
TV
BST
THP
D75
D74
IC8
Q152
Q161
Q162
D251
Q143
Q144
Q145
Q148
Q149
IC10/4
IC9/4
IC12/6
IC11/3
Q115
Q116
Q117
Q118
Q113
Q114
Q96
Q50
Q88
Q89
Q90
Q91
Q92
Q93
Q94
Q95
Q98
Q99
Q111
Q112
1B5
D62
D61
D63
D64
D183
D168
D160
D161
D159
D191
D189
D163
D162
D164
D165
D178
D169
D176
D175
D190
D170
D171
D177
D185
D188
D186
D184
D173
D187
D172
D174
D180
D182
D181
D179
D70
D68
D69
D144
D145
D146
D147
D148
D154
D155
D156
CW

CIRCUIT DESCRIPTION

• ALC circuit in the Signal unit

For all modes, except CW full break-in, forward wave voltage VSF detected in the Filter unit is applied to the base of Q45 in the Signal unit. Q45 and Q44 form a differential amplifier. When VSF is applied, the collector voltage of Q44 rises and that of Q47 drops. The gate voltage of Q52 then drops, as do the base and emitter voltages of Q51. As a result, the ALC line voltage is dropped through D70 and Q51 to control transmitter power. The level at the drain of Q52 is applied to the ALC meter. VR11 is the 0 adjustment, and VR12 is the sensitivity adjustment. For full break-in operation, the TBK signal generated during keying is applied to active low pass filter Q50, where key clicks are removed. This filtered signal is used as the ALC signal and is fed to the ALC line. As previously shown, the ALC voltage not only controls transmission power, but is also used for waveform shaping during CW operation.

• VSWR protection circuit in the Signal unit

Reflected wave voltage VSR is applied to the base of Q48 in the Signal unit. When the reflected power exceeds 25W (an SWR of about 3 : 1), Q48 is turned on and the voltage input to the ALC circuit is dropped to reduce transmission power.

• Final overcurrent protection circuit in the Signal unit

Current flowing through the Final unit 28V line is detected across R14 (0.05Ω). The voltage drop across R14 is amplified by IC4/4 and applied to Q49. When current exceeds approximately 15A, Q49 is turned on and the voltage input to the ALC circuit is dropped to reduce the transmission power.

ANTENNA TUNER

A block diagram of the antenna tuner is shown in Fig. 20. This antenna tuner covers all amateur bands from 3.5 through 29MHz. When the operating frequency is within a 500kHz band segment which includes an amateur band (except the 1.8MHz band), the automatic antenna tuner will operate if the AUTO-THRU switch is set to AUTO. When the operating frequency is at any other frequency, the tuner is automatically bypassed regardless of the AUTO-THRU switch position.

When the AUTO-THRU switch is set to AUTO, voltages proportional to the antenna line voltage and current are induced across the directional coupler terminals. The directional coupler is a toroidal core transformer having excellent characteristics in the 3.5 to 30.0MHz range.

Voltage proportional to the antenna line current is applied to Q30 pin 9, and voltage proportional to the antenna line voltage is applied to Q30 pin 13. Both voltage signals are shaped by Q30 and applied to phase comparator Q29. The output level of Q29 changes according to the relationship between the phase of the antenna line current and voltage. This signal is applied to buffer Q28 pins 10 and 15. The levels at pins 12 and 13 change according to the input level, and these signals are applied to Q31 and Q32 (which control the motor drive circuit consisting of Q14 through Q19) so that motor M1 turns in either one direction or the other, according to the phase relationship, until the phase difference is minimized.

Voltages picked up by the directional coupler are also applied to Q39 pins 4 and 6 for comparison. When the voltage at pin 6 is higher than that at pin 4, the level at pin 1 is "H" and that at pin 2 is "L" (and vice versa). Motor M2 turns in either one direction or the other, according to these levels. The circuit is designed so that VC1 and VC2 (that is, M1 and M2) operate independently. However, since phase and voltage are not independent, both VC1 and VC2 operate as either phase or voltage varies.

When the input voltages to Q39 become equal, the level at pin 5 (or pin 7) is determined by the divider consisting of R100 and R104 (or R105 and R101) so it is lower than the corresponding input level ; then output levels at both pins 1 and 2 go "L", the motor drive circuit turns off and the motor stops.

A current signal proportional to the SWR is derived by the SWR calculation circuit in the Signal unit, and is input to the Antenna tuner unit through the ISW terminal. This current signal is applied to Q40b pin 2 and converted to a voltage signal. The input level at Q39c pin 8 is set to the level equal to the output level of Q40b when the SWR is 1.2. Therefore, the output level at Q39c pin 14 is "H" when SWR is higher than 1.2. This "H" signal is applied to Q11 so that Q11, Q10 and Q34 are turned on and the motor drive circuits are enabled. When SWR becomes 1.2 or less, the level at Q39c pin 14 goes "L". Therefore, Q11, Q10 and Q34 turn off and the motor drive circuits are disabled.

Generally, the tuning motors should run at high speed to reduce the time required to tune the antenna. If this were done, however, inertia would cause the motor to overrun after the motor stops when the SWR becomes 1.2 or less. This would cause the SWR to again become greater than 1.2, and the motor to operate in reverse. This might repeat infinitely. On the other hand, it requires a longer time to tune the antenna if the motor speed is too slow. The motor control system employed in the AT-930 is as follows. Q41 forms a multivibrator and its output is applied to Q40a pin 6. A signal proportional to the SWR is applied to Q40a pin 5. The signal output by Q40 is a pulse whose width increases as the SWR becomes higher, or vice versa. This pulse signal is applied to Q38, then Q34, so that motor speed increases when the SWR is high and reduces when it is low.

CIRCUIT DESCRIPTION

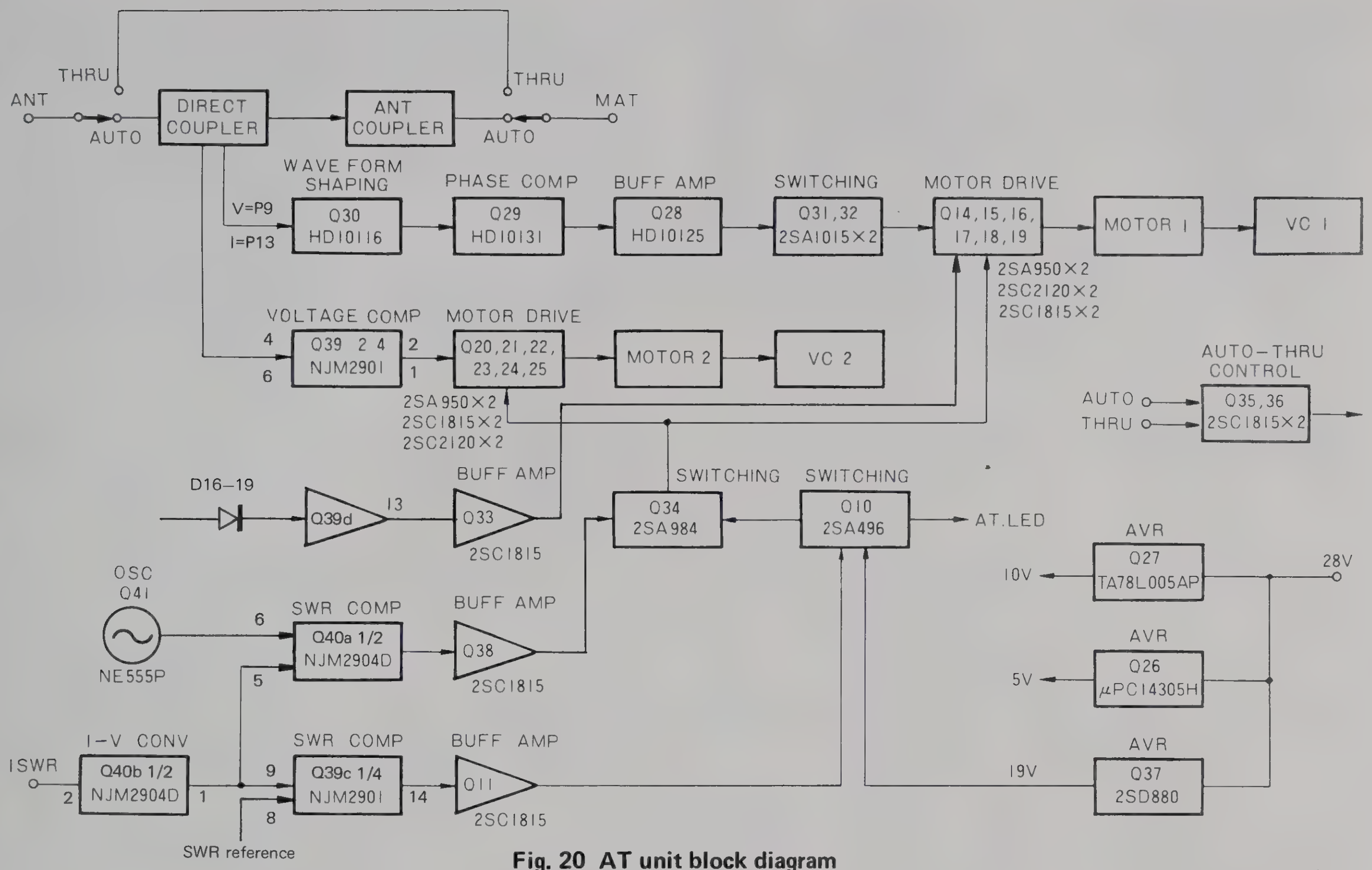

THRU
ANT
AUTO
DIRECT COUPLER
ANT COUPLER
THRU
MAT
AUTO
WAVE FORM SHAPING
V=P9
I=P13
Q30 HD10116
PHASE COMP
Q29 HD10131
BUFF AMP
Q28 HD10125
SWITCHING
Q31,32 2SA1015×2
MOTOR DRIVE
Q14,15,16, 17,18,19
2SA950×2
2SC2120×2
2SC1815×2
MOTOR 1
VC 1
VOLTAGE COMP
4
6
Q39 2 4 NJM2901
2
1
MOTOR DRIVE
Q20,21,22, 23,24,25
2SA950×2
2SC1815×2
2SC2120×2
MOTOR 2
VC 2
AUTO-THRU CONTROL
AUTO
THRU
Q35,36 2SC1815×2
D16–19
Q39d
13
BUFF AMP
Q33
2SC1815
SWITCHING
Q34 2SA984
SWITCHING
Q10 2SA496
AT.LED
OSC Q41
NE555P
6
5
SWR COMP
Q40a 1/2 NJM2904D
BUFF AMP
Q38
2SC1815
AVR
Q27 TA78L005AP
10V
28V
AVR
Q26 μPC14305H
5V
ISWR
2
I-V CONV
Q40b 1/2 NJM2904D
1
9
8
SWR COMP
Q39c 1/4 NJM2901
14
BUFF AMP
Q11
2SC1815
AVR
Q37 2SD880
19V
SWR reference

Fig. 20 AT unit block diagram

The antenna tuner is provided with a protection circuit which disables the AUTO-THRU switch during transmission. When the AUTO-THRU switch is at THRU, D13 is on, D14 is off and Q36 is off. Q35 is on because a "H" is applied through D15. The "H" at the collector of Q36 is applied to Q8 through D9 and turnes Q8 on. Thus, Q7 is on and relay RL1 is actuated. When the AUTO-THRU switch is at AUTO, D12 is on, so D11 and Q35 are off. The collector level at Q35 is applied to Q36 through D10 so Q36 is on. Therefore, Q36 collector level is "L" and Q8 is off. Thus, Q7 and RL1 are off. During transmission, RXB is "L" and both D12 and D13 are turned off, so the AUTO-THRU switch is disconnected from Q35 and Q36. Therefore, the AUTO-THRU switch has no affect.

The BAND data signals for the 3.5MHz to 29MHz Amateur bands are sent from the Digital unit through terminals AT1 to AT6. (See Table 6.) The AT1 signal is used for automatic antenna tuner control ; its level is "H" when the operating frequency is within a 500kHz Amateur band segment. At such time, Q9 is on and D8 is off. This allows Q8 to be controlled through D9. When the level is "L", Q9 is off and D8 is on. Therefore, the level at the base of Q8 is maintained at "H" through R17. (Q8 is always on ; that is, the tuner is in the THRU state.)

The matching circuit used is a "T" configuration when the operating frequency is between 3.5MHz and 14MHz, and a π configuration when the operating frequency is 18MHz or above. Switching between the two is performed by relay RL8. When the motors are operating, the green LED ingicator on the front panel lights. This indicator goes off when the motors stop at best match.

BAND	AT1	AT2	AT3	AT4	AT5	AT6
3.5	○	○	○	○		
7	○		○	○		
10	○			○		
14	○			○		○
18,21	○					
24.5,28	○				○	

○ : High Level

Table 6

FILTER DATA

Item	Rating
Nominal center frequency	44.930MHz
Pass bandwidth	±6kHz or more at 6dB
Attenuation bandwidth	±25kHz or less at 30dB
Ripple	1.5dB or less
Loss	4dB or less
Guaranteed attenuation	60dB or more within ±1MHz
Input and output impedance	2kΩ ± 10%

MCF (L71-0234-05) (Signal unit XF1,2)

Item	Rating
Nominal center frequency	8830kHz
Center frequency deviation	Within ±150Hz at 6dB
Pass bandwidth	±1.5kHz or more at 6dB
Attenuation bandwidth	±1.9kHz or less at 20dB ±2.75kHz or less at 60dB ±3.5kHz or less at 80dB
Ripple	2dB or less
Loss	6dB or less
Guaranteed attenuation	80dB or more within ±3.5kHz—±1MHz
Input and output impedance	600Ω / 15pF

MCF (L71-0235-05) (Signal unit XF3)

Item	Rating
Nominal center frequency	455kHz
6dB bandwidth	±3kHz or more
50dB bandwidth	±9kHz or less
Ripple (within 455 ± 2kHz)	2dB or less
Loss	6dB or less
Guaranteed attenuation (within 455kHz ± 100kHz)	60dB or more
Input and output impedance	2.0kΩ

AM ceramic filter (L72-0319-05) (Signal unit CF2)

Item	Rating
Center frequency	455 ± 0.20kHz
6dB bandwidth	2.9—3.2kHz
60dB bandwidth	4.7kHz or less
Guaranteed attenuation (0.1—1MHz)	60dB or more
Spurious (600—700kHz)	40dB or more
Ripple	2dB or less
Loss	6dB or less
Input and output impedance	2kΩ

SSB ceramic filter (L72-0334-05) (Signal unit CF1)

Item	Rating
Nominal center frequency	8830.0kHz
Center frequency deviation	Within ±70Hz at 6dB (25°C)
Pass bandwidth	±250Hz or more at 6dB
Attenuation bandwidth	±900Hz or less at 60dB
Guaranteed attenuation	80dB or more within ±2kHz—±1MHz
Ripple	2dB or less
Loss	Within 5dB ± 2dB
Input and output impedance	600Ω / 15pF

CW crystal filter YK-88C-1
(L71-0236-05) Option

Item	Rating
Nominal center frequency	8830.0kHz
Center frequency deviation	Within ±250Hz at 6dB
Pass bandwidth	±3.0kHz or more at 6dB
Attenuation bandwidth	±6kHz or less at 60dB ±10kHz or less at 80dB
Ripple	2dB or less
Loss	Within 3dB ± 2dB
Guaranteed attenuation	80dB or more within ±10kHz—±1MHz
Input and output impedance	600Ω / 15pF

AM crystal filter YK-88A-1
(L71-0237-05) Option

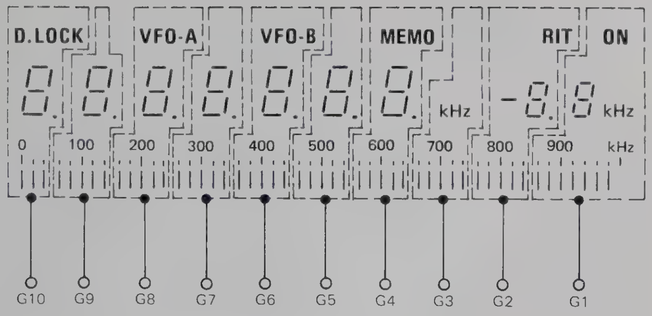
Item	Rating
Center frequency	455kHz
Center frequency deviation	Within 50Hz at 6dB
Pass bandwidth	±250Hz or more at 6dB
Attenuation bandwidth	±425Hz or less at 60dB
Ripple	2dB or less
Loss	6dB or less
Guaranteed attenuation	80dB or more within 100Hz—454.4kHz 80dB or more within 455.6kHz—2MHz
Input and output impedance	2kΩ ± 5% / 15pF ± 5%

CW crystal filter YG-455C-1
(L72-0238-05) Option

Item	Rating
Center frequency	455kHz
Center frequency deviation	Within 50Hz at 6dB
Pass bandwidth	±125Hz or more at 6dB
Attenuation bandwidth	±250Hz or less at 60dB
Ripple	2dB or less
Loss	6dB or less
Guaranteed attenuation	80dB or more within 100Hz—454.6kHz 80dB or more within 455.4kHz—2MHz
Input and output impedance	2kΩ ± 5% / 15pF ± 5%

CW crystal filter YG-455CN-1
(L72-0239-05) Option

SEMICONDUCTOR DATA

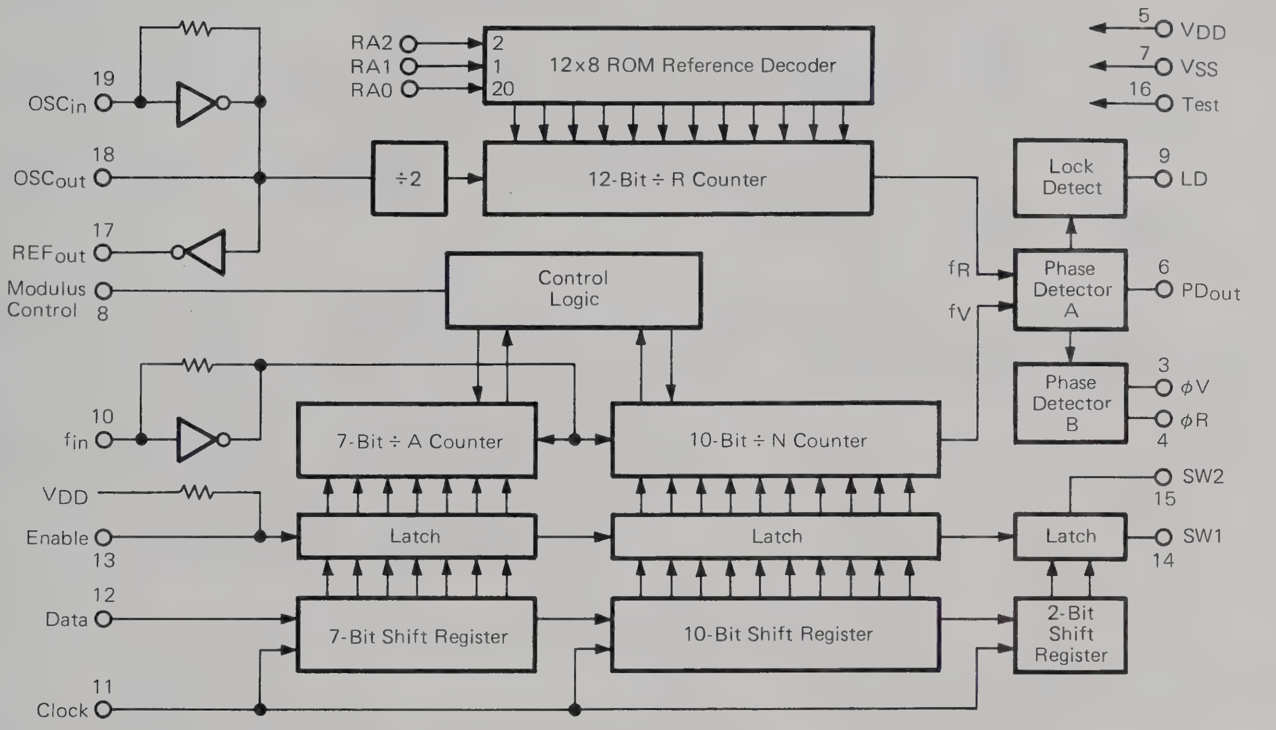

D.LOCK
VFO-A
VFO-B
MEMO
RIT
ON
kHz
kHz
0
100
200
300
400
500
600
700
800
900
kHz
G10
G9
G8
G7
G6
G5
G4
G3
G2
G1

11-BT-03Z (Switch unit V1)

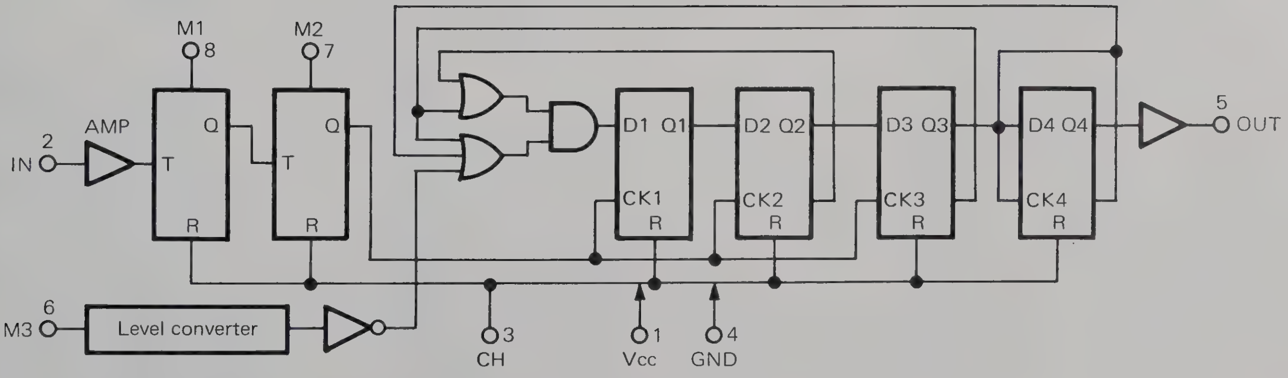
Item	Symbol	Rating
Gate-Drain voltage	V_{CDO}	−25V
Gate-Source voltage	V_{GSO}	−25V
Continuous Drain current	I_D	100mA
Continuous Gate current	I_G	10mA
Power dissipation	Pch	500mW
Channel temperature	Tch	120°C
Storage temperature	Tstg	−50~+120°C

Ta=25°C

2SK125P MAX. Rating (RF unit Q1,2)

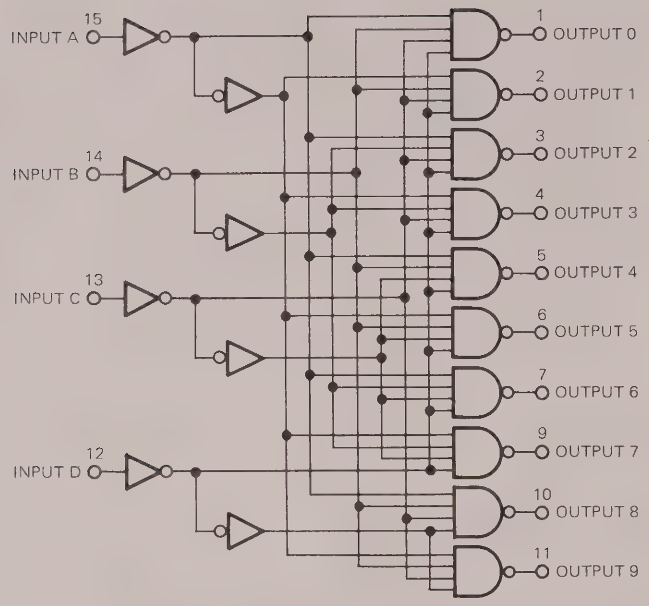

19
OSCin
18
OSCout
17
REFout
Modulus Control 8
10
fin
VDD
Enable 13
12
Data
11
Clock
RA2
RA1
RA0
2
1
20
12×8 ROM Reference Decoder
÷2
12-Bit ÷ R Counter
Control Logic
7-Bit ÷ A Counter
10-Bit ÷ N Counter
Latch
Latch
7-Bit Shift Register
10-Bit Shift Register
5 VDD
7 VSS
16 Test
Lock Detect
9 LD
fR
fV
Phase Detector A
6 PDout
Phase Detector B
3 φV
φR 4
SW2 15
Latch
SW1 14
2-Bit Shift Register

MC145156P Block diagram (PLL unit IC5)


M1 8
M2 7
IN 2
AMP
T
Q
R
T
Q
R
D1 Q1
CK1
R
D2 Q2
CK2
R
D3 Q3
CK3
R
D4 Q4
CK4
R
5 OUT
M3 6
Level converter
3 CH
1 Vcc
4 GND

µPB551C Block diagram (PLL unit IC8)

SEMICONDUCTOR DATA



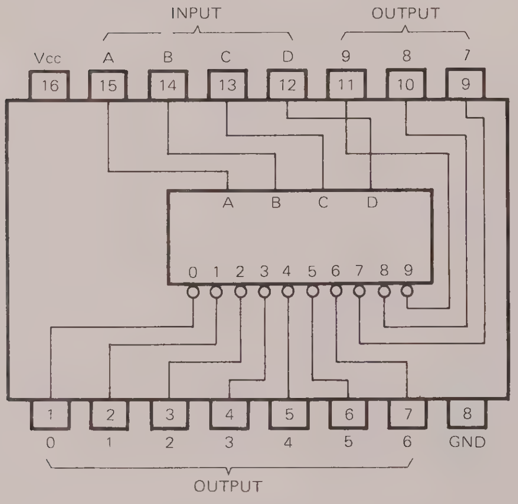
15
INPUT A
14
INPUT B
13
INPUT C
12
INPUT D
1
OUTPUT 0
2
OUTPUT 1
3
OUTPUT 2
4
OUTPUT 3
5
OUTPUT 4
6
OUTPUT 5
7
OUTPUT 6
9
OUTPUT 7
10
OUTPUT 8
11
OUTPUT 9

MB74LS42 Block diagram (LPF unit IC1)

No.	BCD input				Decimal output data									
	D	C	B	A	0	1	2	3	4	5	6	7	8	9
0	L	L	L	L	L	H	H	H	H	H	H	H	H	H
1	L	L	L	H	H	L	H	H	H	H	H	H	H	H
2	L	L	H	L	H	H	L	H	H	H	H	H	H	H
3	L	L	H	H	H	H	H	L	H	H	H	H	H	H
4	L	H	L	L	H	H	H	H	L	H	H	H	H	H
5	L	H	L	H	H	H	H	H	H	L	H	H	H	H
6	L	H	H	L	H	H	H	H	H	H	L	H	H	H
7	L	H	H	H	H	H	H	H	H	H	H	L	H	H
8	H	L	L	L	H	H	H	H	H	H	H	H	L	H
9	H	L	L	H	H	H	H	H	H	H	H	H	H	L
	H	L	H	L	H	H	H	H	H	H	H	H	H	H
	H	L	H	H	H	H	H	H	H	H	H	H	H	H
	H	H	L	L	H	H	H	H	H	H	H	H	H	H
	H	H	L	H	H	H	H	H	H	H	H	H	H	H
	H	H	H	L	H	H	H	H	H	H	H	H	H	H
	H	H	H	H	H	H	H	H	H	H	H	H	H	H

H : High level, L : Low level

MB74LS42 Functions table



INPUT
OUTPUT
Vcc
A
B
C
D
9
8
7
16
15
14
13
12
11
10
9
A
B
C
D
0
1
2
3
4
5
6
7
8
9
1
2
3
4
5
6
7
8
0
1
2
3
4
5
6
GND
OUTPUT

MB74LS42

Item	V_{CBO}	V_{CEO}	V_{EBO}	I_C	icp	Pc	Tj	Tstg
Condition						Tc= 25°C		
Rating	−100V	−80V	−5V	−500mA	−800mA	600mW	150°C	−55~ +150°C

Ta=25°C

2SK984K MAX. Rating
(Digital unit Q1,16, Signal unit Q23)

Item	V_{CBO}	V_{CEO}	V_{EBO}	I_C	icp	Pc	Tj	Tstg
Condition						Tc= 25°C		
Rating	100V	80V	5V	500mA	800mA	600mW	150°C	−55~ +150°C

Ta = 25°C

2SC2274K MAX. Rating (Digital unit Q14,15)

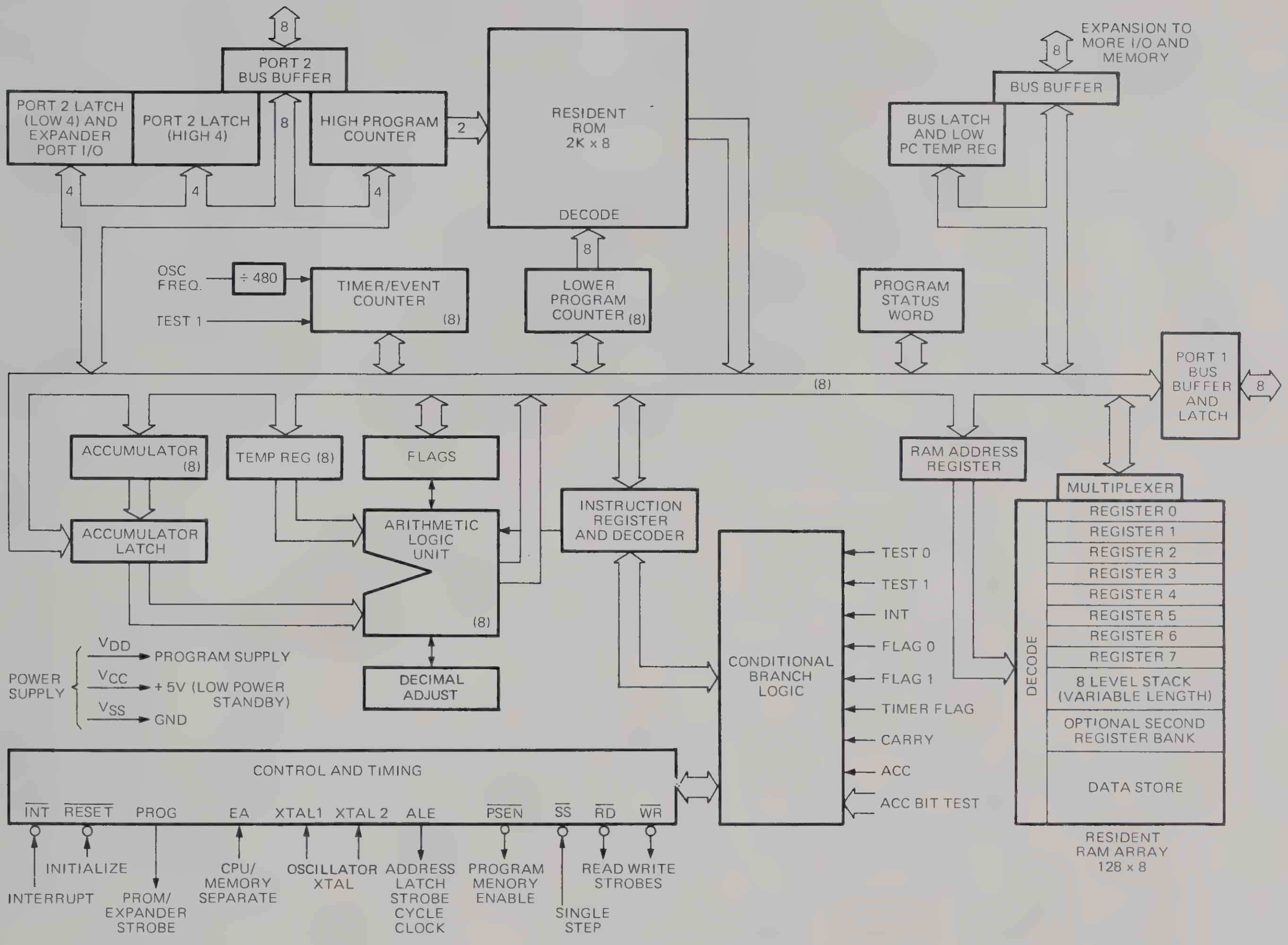
Item	Symbol	Rating
Collector-Emitter voltage	V_{CEO}	35V
Collector-Base voltage	V_{CBO}	65V
Emitter-Base voltage	V_{EBO}	4.0V
Continuous Collector current	I_C	1.0A
Total device dissipation Tc=50°C Derate above 50°C	P_D	30W 0.3W/°C
Storage temperature	Tstg	−65~+150°C

MRF485 MAX. Rating (100W Final unit Q2,3)

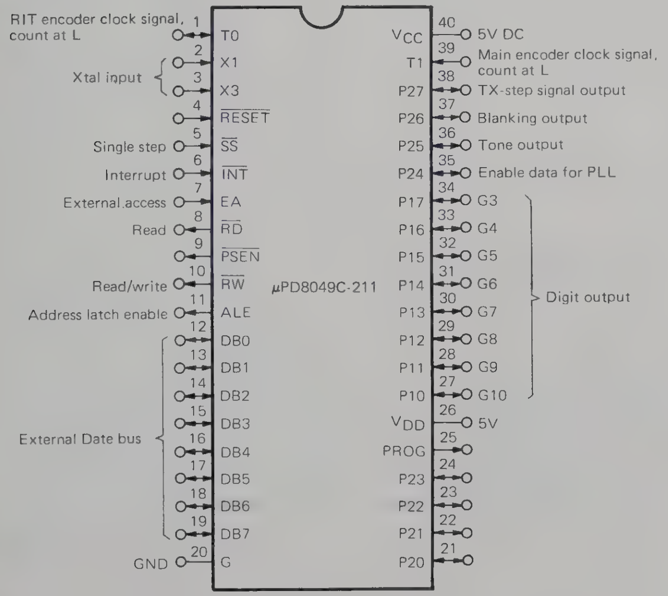
Item	Symbol	Rating
Collector-Emitter voltage	V_{CEO}	40V
Collector-Base voltage	V_{CBO}	85V
Emitter-Base voltage	V_{EBO}	3.0V
Continuous Collector current	I_C	20A
Withstanding current −10s	—	30A
Total device dissipation Tc=25°C Derate above 25°C	P_D	290W 1.66W/°C
Storage temperature	Tstg	−65~+200°C

MRF422 MAX. Rating (100W Final unit Q4,5)

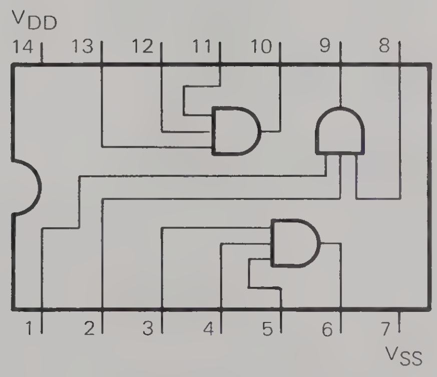
SEMICONDUCTOR DATA


8
PORT 2 BUS BUFFER
PORT 2 LATCH (LOW 4) AND EXPANDER PORT I/O
PORT 2 LATCH (HIGH 4)
HIGH PROGRAM COUNTER
RESIDENT ROM 2K x 8
DECODE
EXPANSION TO MORE I/O AND MEMORY
BUS BUFFER
BUS LATCH AND LOW PC TEMP REG
OSC FREQ.
÷ 480
TEST 1
TIMER/EVENT COUNTER (8)
LOWER PROGRAM COUNTER (8)
PROGRAM STATUS WORD
PORT 1 BUS BUFFER AND LATCH
(8)
ACCUMULATOR (8)
TEMP REG (8)
FLAGS
RAM ADDRESS REGISTER
MULTIPLEXER
ACCUMULATOR LATCH
ARITHMETIC LOGIC UNIT (8)
INSTRUCTION REGISTER AND DECODER
REGISTER 0
REGISTER 1
REGISTER 2
REGISTER 3
REGISTER 4
REGISTER 5
REGISTER 6
REGISTER 7
8 LEVEL STACK (VARIABLE LENGTH)
OPTIONAL SECOND REGISTER BANK
DATA STORE
DECODE
RESIDENT RAM ARRAY 128 x 8
TEST 0
TEST 1
INT
FLAG 0
FLAG 1
TIMER FLAG
CARRY
ACC
ACC BIT TEST
CONDITIONAL BRANCH LOGIC
POWER SUPPLY
VDD PROGRAM SUPPLY
VCC +5V (LOW POWER STANDBY)
VSS GND
DECIMAL ADJUST
CONTROL AND TIMING
INT RESET PROG EA XTAL1 XTAL 2 ALE PSEN SS RD WR
INITIALIZE
INTERRUPT
PROM/ EXPANDER STROBE
CPU/ MEMORY SEPARATE
OSCILLATOR XTAL
ADDRESS LATCH STROBE CYCLE CLOCK
PROGRAM MEMORY ENABLE
SINGLE STEP
READ WRITE STROBES

μPD8049C-211 Block diagram (Digital unit IC6)

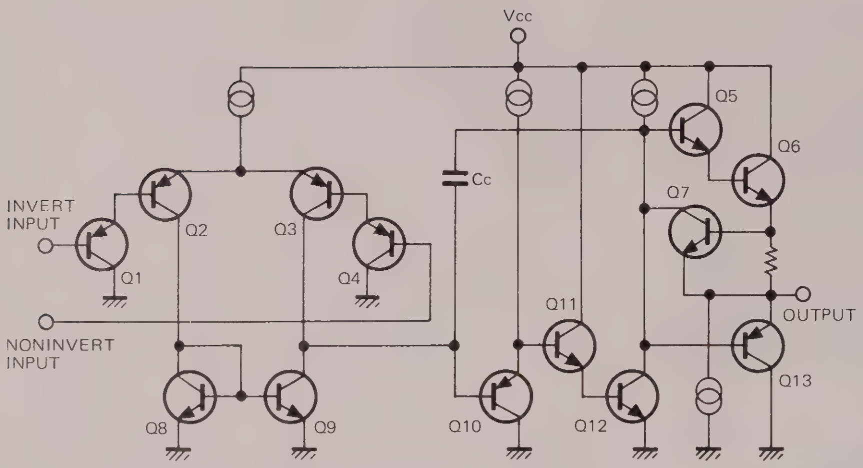

RIT encoder clock signal, count at L 1 T0
Xtal input 2 X1 3 X3
4 RESET
Single step 5 SS
Interrupt 6 INT
External access 7 EA
Read 8 RD
9 PSEN
Read/write 10 RW
Address latch enable 11 ALE
External Date bus
12 DB0
13 DB1
14 DB2
15 DB3
16 DB4
17 DB5
18 DB6
19 DB7
GND 20 G
μPD8049C-211
40 VCC 5V DC
39 T1 Main encoder clock signal, count at L
38 P27 TX-step signal output
37 P26 Blanking output
36 P25 Tone output
35 P24 Enable data for PLL
Digit output
34 P17 G3
33 P16 G4
32 P15 G5
31 P14 G6
30 P13 G7
29 P12 G8
28 P11 G9
27 P10 G10
26 VDD 5V
25 PROG
24 P23
23 P22
22 P21
21 P20

μPD8049C-211

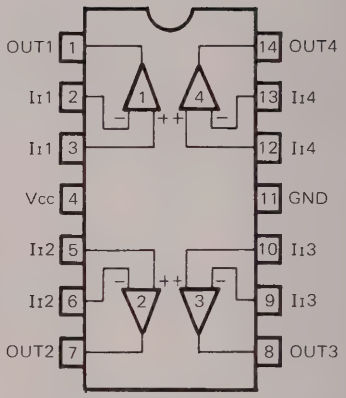

VDD
14 13 12 11 10 9 8
1 2 3 4 5 6 7
VSS

TC4073BP (Signal unit IC11)

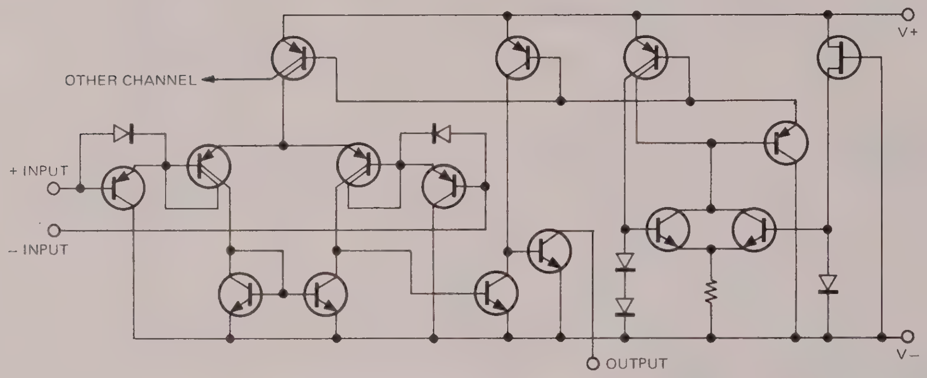
SEMICONDUCTOR DATA


Vcc
Q5
Q6
Q7
Cc
INVERT INPUT
Q1
Q2
Q3
Q4
NONINVERT INPUT
Q11
OUTPUT
Q13
Q8
Q9
Q10
Q12

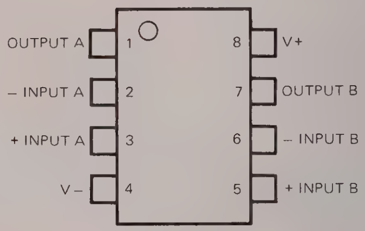
MB3614 Equivalent circuit (Signal unit IC4,7)


OUT1 1
II1 2
II1 3
Vcc 4
II2 5
II2 6
OUT2 7
14 OUT4
13 II4
12 II4
11 GND
10 II3
9 II3
8 OUT3
1
2
3
4

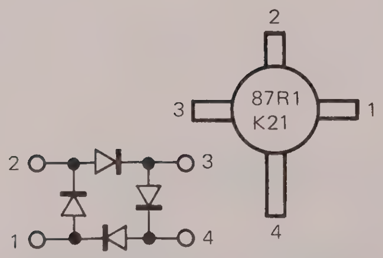
MB3614 (TOP VIEW)


OTHER CHANNEL
+ INPUT
– INPUT
V+
V–
OUTPUT

NJM2903D Equivalent circuit (Signal unit IC5)


OUTPUT A 1
– INPUT A 2
+ INPUT A 3
V– 4
8 V+
7 OUTPUT B
6 – INPUT B
5 + INPUT B

NJM2903D


2
3
1
4
87R1
K21
2
3
1
4

ND487R1-3R (Signal unit D140)

Item	V_{CBO}	V_{CEO}	V_{EBO}	I_C	icp	I_B	Pc	Tj	Tstg
Condition							Tc=25°C		
Rating	500V	400V	10V	0.5A	1.0A	0.75A	10W	150°C	–55~+150°C

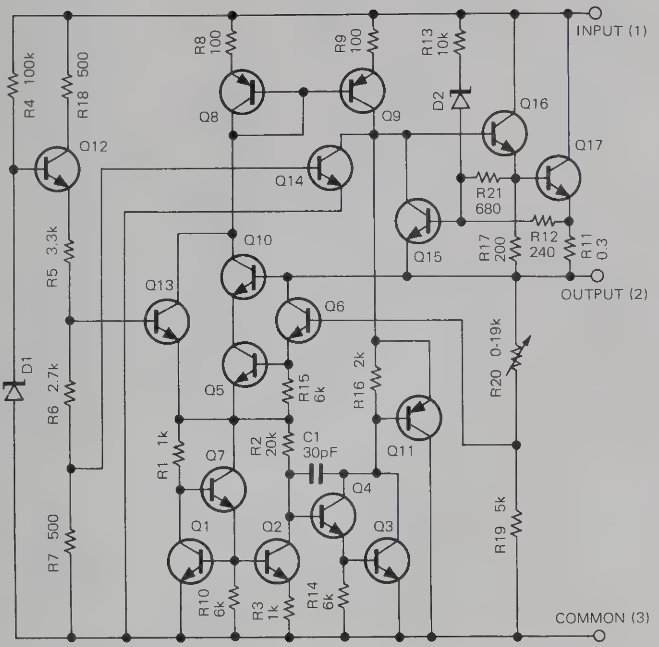
Ta = 25°C

2SC2899 MAX. Rating (Signal unit Q22)

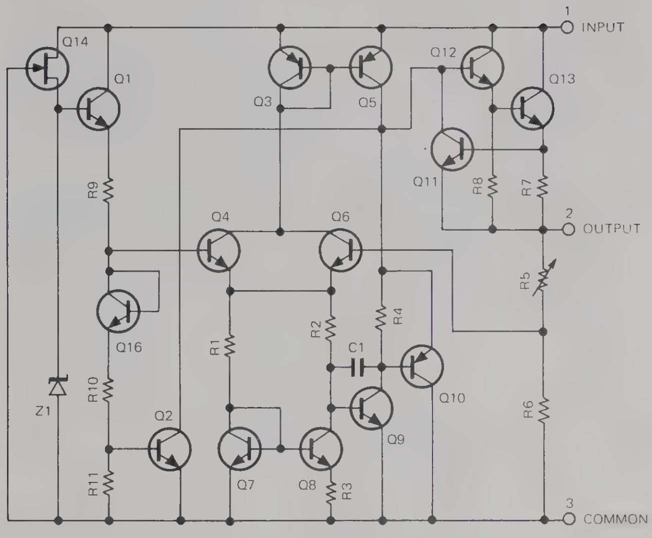
Item	Rating
Maximum permissible voltage	AC 130V rms DC 170V
Varistor voltage	180~255V
Maximum restriction voltage	340V at 10A
Maximum average pulse power	0.25W
Maximum surge current	600A

ERZ-C07DK201 MAX. Rating (Signal unit D101)

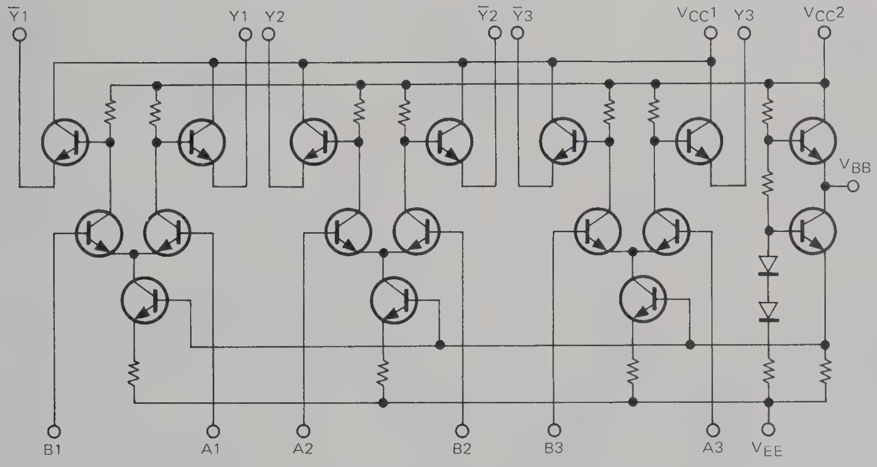
SEMICONDUCTOR DATA


INPUT (1)
OUTPUT (2)
COMMON (3)
R4 100k
R18 500
R8 100
R9 100
R13 10k
D2
Q8
Q9
Q16
Q17
Q12
Q14
R21 680
R17 200
R12 240
R11 0.3
Q15
R5 3.3k
Q10
Q13
Q6
Q5
R15 6k
R16 2k
R20 0-19k
D1
R6 2.7k
R1 1k
R2 20k
C1 30pF
Q11
Q7
Q4
R7 500
Q1
Q2
Q3
R19 5k
R10 6k
R3 1k
R14 6k

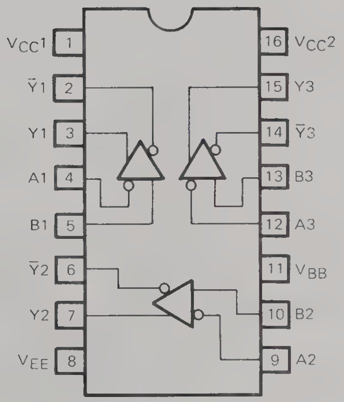
UA7818UC Equivalent circuit (Signal unit IC8)


1 INPUT
2 OUTPUT
3 COMMON
Q14
Q1
Q3
Q5
Q12
Q13
Q11
R8
R7
R9
Q4
Q6
R5
Q16
R1
R2
R4
C1
Q10
R6
Z1
R10
Q2
Q7
Q8
Q9
R3
R11

TA78L005AP Equivalent circuit (AT unit Q27)


$\overline{Y}1$
Y1
Y2
$\overline{Y}2$
$\overline{Y}3$
$V_{CC}1$
Y3
$V_{CC}2$
V_{BB}
B1
A1
A2
B2
B3
A3
V_{EE}

HD10116 Equivalent circuit (AT unit Q30)


$V_{CC}1$ 1
$\overline{Y}1$ 2
Y1 3
A1 4
B1 5
$\overline{Y}2$ 6
Y2 7
V_{EE} 8
9 A2
10 B2
11 V_{BB}
12 A3
13 B3
14 $\overline{Y}3$
15 Y3
16 $V_{CC}2$

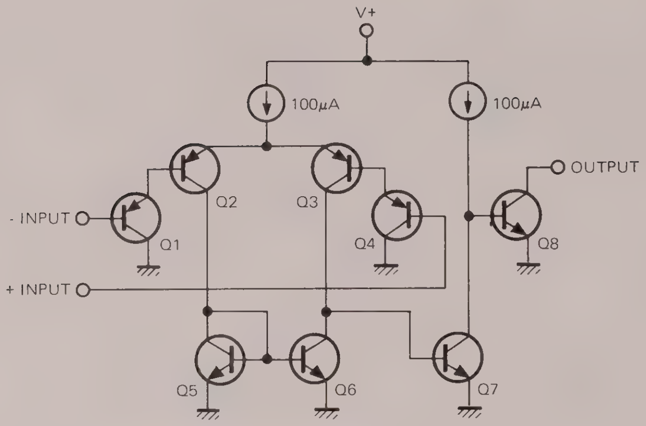
HD10116 (TOP VIEW)

Item	Symbol	Rating
Collector-Base voltage	V_{CBO}	−35V
Collector-Emitter voltage	V_{CEO}	−30V
Emitter-Base voltage	V_{EBO}	−5V
Continuous Collector current	I_C	−800mA
Continuous Emitter current	I_E	800mA
Collector dissipation	P_C	600mW
Operating temperature	Tj	150°C
Storage temperature	Tstg	−55~+150°C

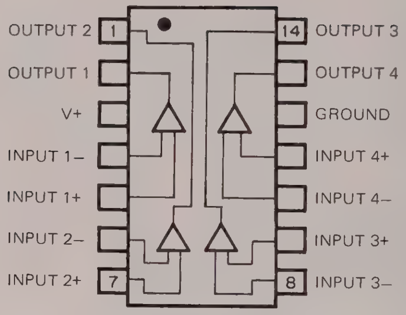
Ta=25°C

2SA950 MAX. Rating (AT unit Q14,15,20,21)

SEMICONDUCTOR DATA


V+
100μA
100μA
OUTPUT
- INPUT
+ INPUT
Q1
Q2
Q3
Q4
Q5
Q6
Q7
Q8

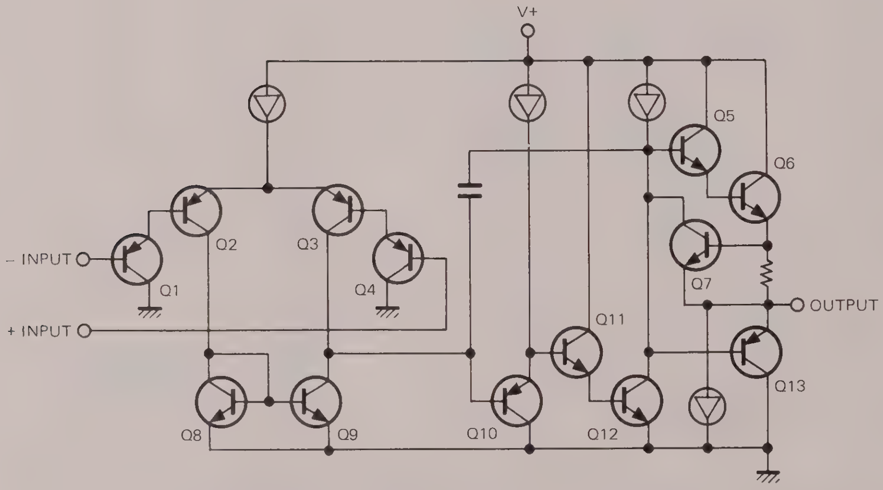
NJM2901 Equivalent circuit (AT unit Q39)


OUTPUT 2
OUTPUT 1
V+
INPUT 1–
INPUT 1+
INPUT 2–
INPUT 2+
1
7
14
8
OUTPUT 3
OUTPUT 4
GROUND
INPUT 4+
INPUT 4–
INPUT 3+
INPUT 3–

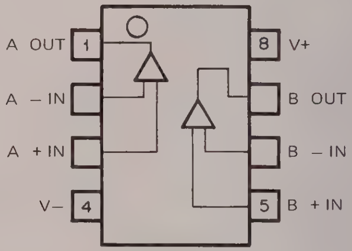
NJM2901

Item	Voltage supply	Power consumption	Differential input voltage	Input voltage	Operating temperature	Storage temperature
Symbol	Vs	P_T	V_{IDR}	V_{ICR}	Topr	Tstg
Rating	36V	570mW	36V	–0.3~+36V	–40~+85°C	–50~+125°C

NJM2901 MAX. Rating


V+
– INPUT
+ INPUT
OUTPUT
Q1
Q2
Q3
Q4
Q5
Q6
Q7
Q8
Q9
Q10
Q11
Q12
Q13

NJM2904D Equivalent circuit (AT unit Q40)

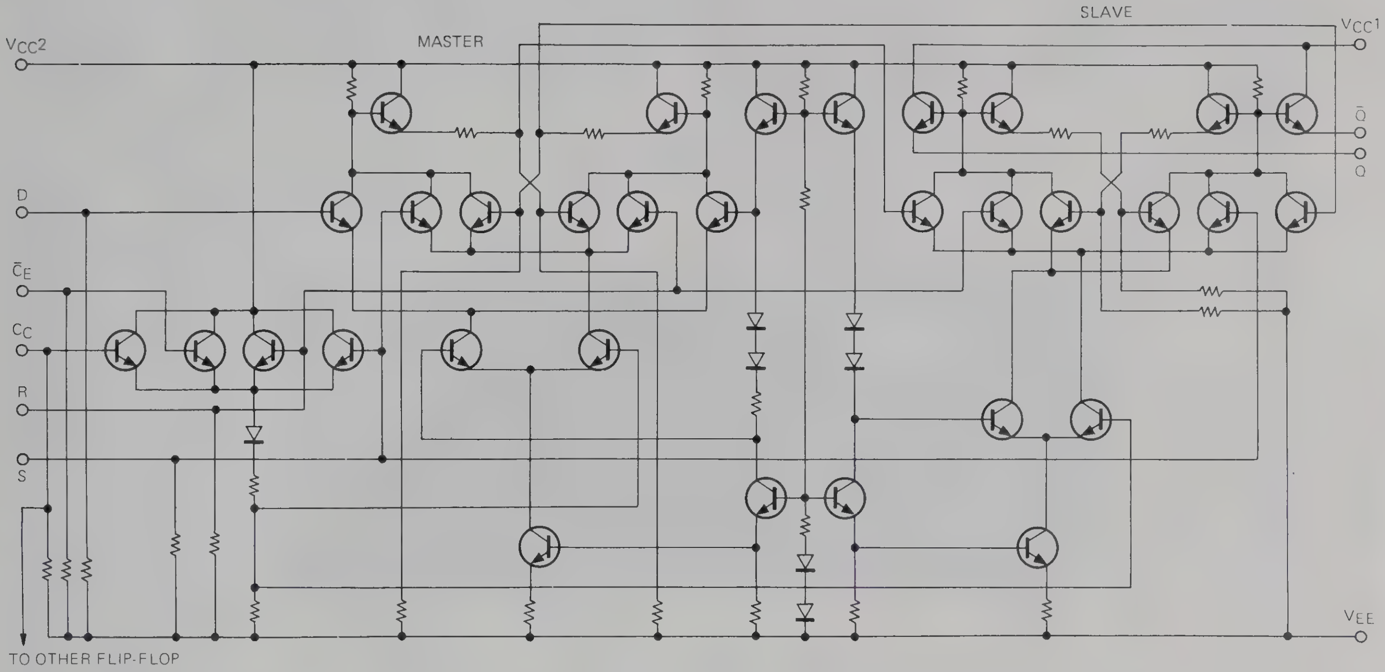

A OUT
A – IN
A + IN
V–
1
4
8
5
V+
B OUT
B – IN
B + IN

NJM2904D

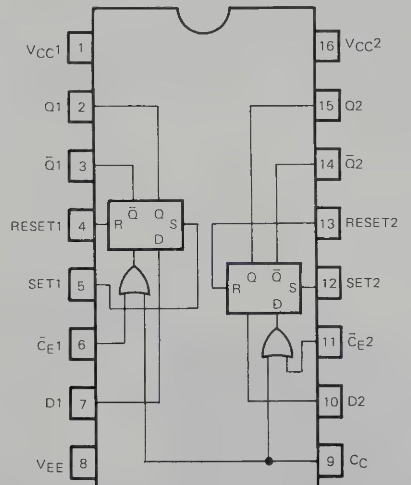
Item	Voltage supply	Power consumption	Differential input voltage	Input voltage	Operating temperature	Storage temperature
Symbol	Vs	P_T	V_{ID}	V_{ICM}	Topr	Tstg
Rating	32±16V	500mW	–0.3~+26V	–0.3~+32V	–20~+75°C	–40~+125°C

NJM2904D MAX. Rating

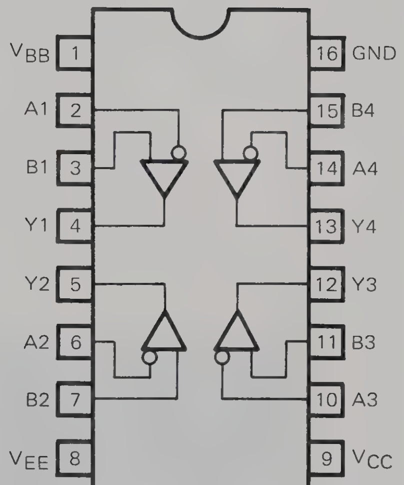
SEMICONDUCTOR DATA


VCC2
MASTER
SLAVE
VCC1
Q̄
Q
Q
D
C̄E
CC
R
S
VEE
TO OTHER FLIP-FLOP

HD10131 Equivalent circuit 1/2 (AT unit Q29)

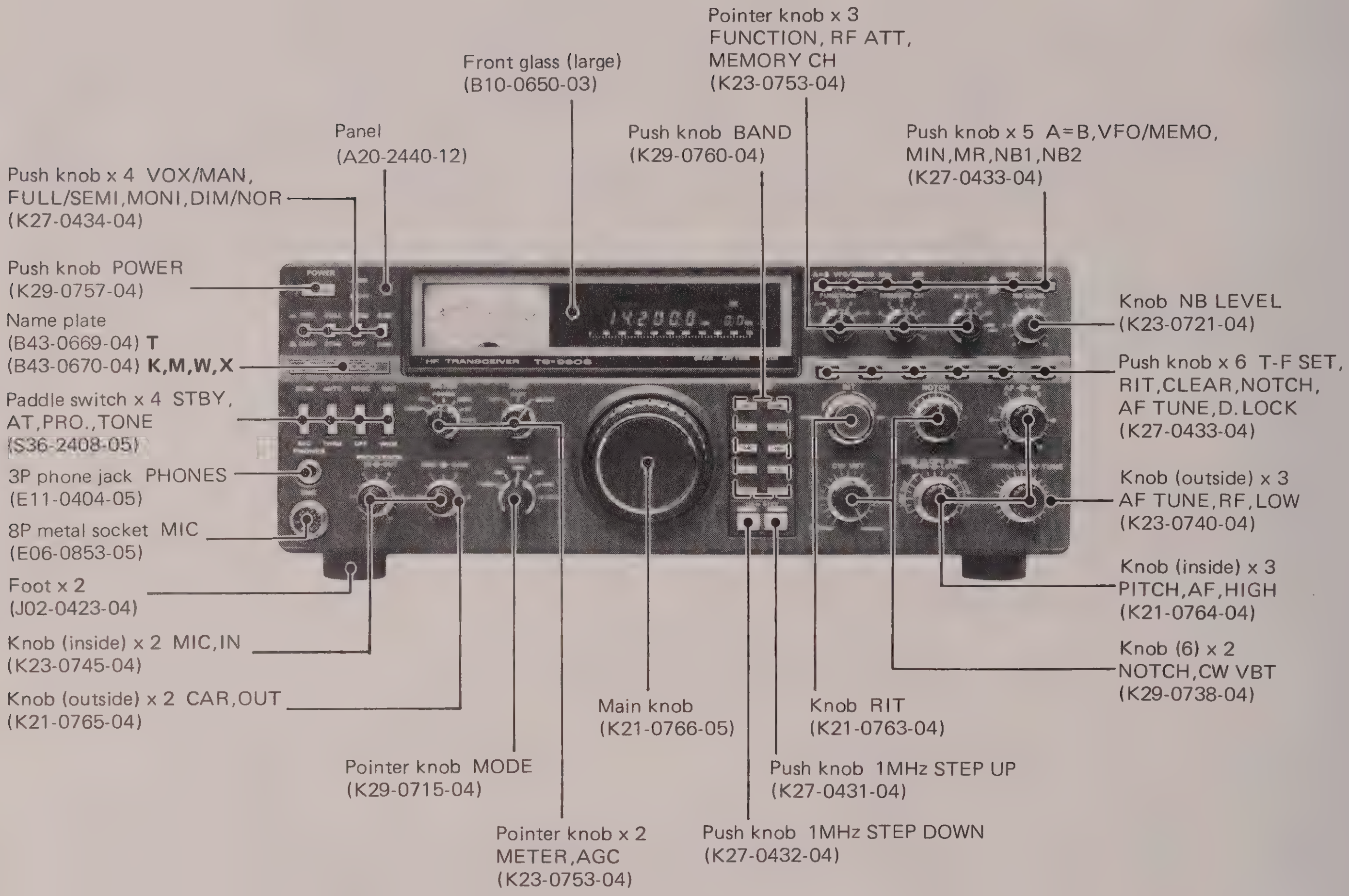

VCC1 1
Q1 2
Q̄1 3
RESET1 4
SET1 5
C̄E1 6
D1 7
VEE 8
16 VCC2
15 Q2
14 Q̄2
13 RESET2
12 SET2
11 C̄E2
10 D2
9 CC
R
Q̄
Q
S
D

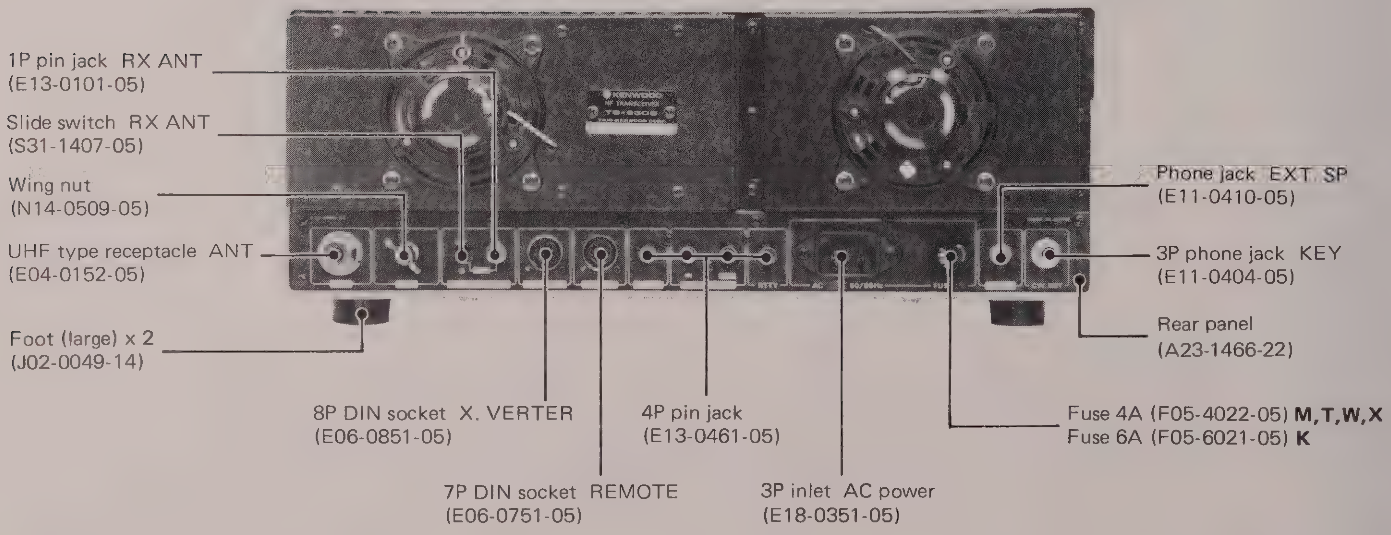
HD10131 (TOP VIEW)


VBB 1
A1 2
B1 3
Y1 4
Y2 5
A2 6
B2 7
VEE 8
16 GND
15 B4
14 A4
13 Y4
12 Y3
11 B3
10 A3
9 VCC

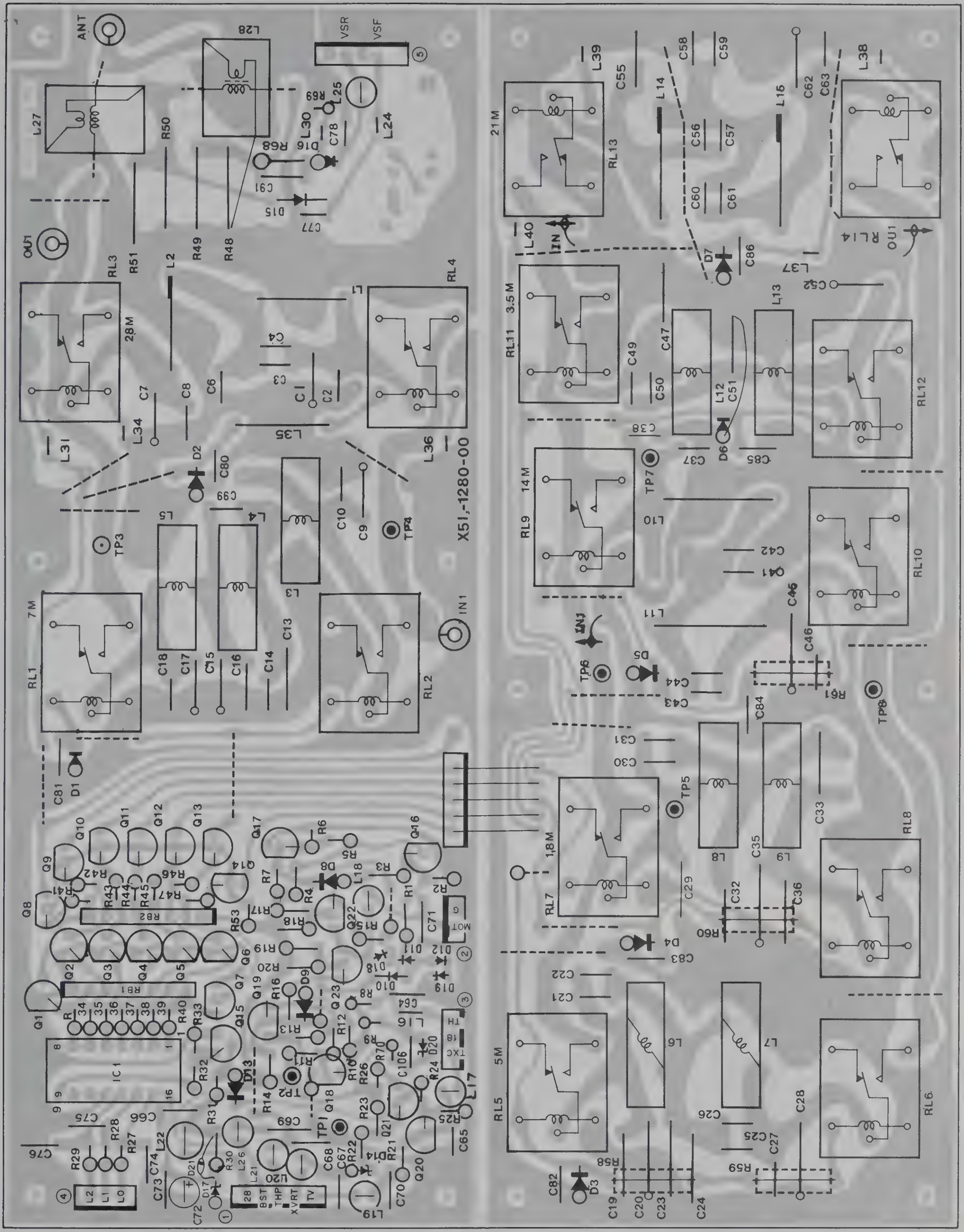
HD10125 (AT unit Q28)
(TOP VIEW)

OUTSIDE VIEWS


Pointer knob x 3
FUNCTION, RF ATT,
MEMORY CH
(K23-0753-04)
Front glass (large)
(B10-0650-03)
Panel
(A20-2440-12)
Push knob BAND
(K29-0760-04)
Push knob x 5 A=B,VFO/MEMO,
MIN,MR,NB1,NB2
(K27-0433-04)
Push knob x 4 VOX/MAN,
FULL/SEMI,MONI,DIM/NOR
(K27-0434-04)
Push knob POWER
(K29-0757-04)
Name plate
(B43-0669-04) T
(B43-0670-04) K,M,W,X
Paddle switch x 4 STBY,
AT,PRO.,TONE
(S36-2408-05)
3P phone jack PHONES
(E11-0404-05)
8P metal socket MIC
(E06-0853-05)
Foot x 2
(J02-0423-04)
Knob (inside) x 2 MIC,IN
(K23-0745-04)
Knob (outside) x 2 CAR,OUT
(K21-0765-04)
Pointer knob MODE
(K29-0715-04)
Pointer knob x 2
METER,AGC
(K23-0753-04)
Main knob
(K21-0766-05)
Push knob 1MHz STEP DOWN
(K27-0432-04)
Push knob 1MHz STEP UP
(K27-0431-04)
Knob RIT
(K21-0763-04)
Knob NB LEVEL
(K23-0721-04)
Push knob x 6 T-F SET,
RIT,CLEAR,NOTCH,
AF TUNE,D.LOCK
(K27-0433-04)
Knob (outside) x 3
AF TUNE,RF,LOW
(K23-0740-04)
Knob (inside) x 3
PITCH,AF,HIGH
(K21-0764-04)
Knob (6) x 2
NOTCH,CW VBT
(K29-0738-04)

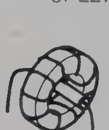

1P pin jack RX ANT
(E13-0101-05)
Slide switch RX ANT
(S31-1407-05)
Wing nut
(N14-0509-05)
UHF type receptacle ANT
(E04-0152-05)
Foot (large) x 2
(J02-0049-14)
8P DIN socket X. VERTER
(E06-0851-05)
7P DIN socket REMOTE
(E06-0751-05)
4P pin jack
(E13-0461-05)
3P inlet AC power
(E18-0351-05)
Fuse 4A (F05-4022-05) M,T,W,X
Fuse 6A (F05-6021-05) K
Rear panel
(A23-1466-22)
3P phone jack KEY
(E11-0404-05)
Phone jack EXT. SP
(E11-0410-05)

LPF UNIT (X51-1280-00) **Component side view**

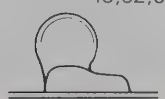

ANT
L28
VSR
VSF
⑤
L27
R50
R69
L25
L30
C78
L24
R68
D16
C91
D15
C77
OUT
R51
L2
R49
R48
RL3
28M
RL4
L1
C4
C3
C1
C2
C7
C8
C6
L34
L31
L36
L35
D2
C80
C99
L5
L4
L3
C10
C9
TP4
TP3
X51,-1280-00
7M
RL1
RL2
IN1
C18
C17
C15
C16
C14
C13
C81
D1
Q8
Q9
Q10
Q11
Q12
Q13
Q14
Q16
Q17
R41
R42
R43
R44
R45
R46
R47
RB2
R53
R6
R5
R7
D8
R3
L18
R4
R1
R2
R17
R18
Q22
R15
C71
MOT
Q1
Q2
Q3
Q4
Q5
Q6
Q7
RB1
R19
R20
D11
D12
②
R16
D9
D18
D10
D19
R8
R
34
35
36
37
38
39
R40
R33
Q15
Q19
Q23
C64
R13
R12
L16
③
IC1
8
1
9
16
R32
D13
R11
TP2
R10
R26
R70
C106
R24
D20
TXC
TH
R31
R14
Q18
R23
L17
R25
C75
C66
C69
TP1
R22
Q21
C65
C76
R29
R28
R27
L22
C74
C73
D21
D17
R30
L26
L21
U20
C67
C68
D14
R21
C70
Q20
④
L2
L1
L0
C72
①
28
BST
THP
XVRT
TV
L19
L39
C55
C58
C59
L38
21M
L14
L15
C62
C63
RL13
C56
C57
C60
C61
L40
IN
D7
C86
RL14
OUT
L37
C52
3.5M
RL11
C49
C47
L13
C50
L12
C51
RL12
C38
C37
D6
C85
14M
RL9
TP7
L10
C42
Q41
RL10
C45
L11
IN
C46
TP6
D5
C44
C43
R61
TP8
C84
C31
C30
TP5
1.8M
RL7
L8
L9
C35
C33
RL8
C29
C32
C36
R60
D4
C83
C22
C21
5M
RL5
L6
L7
RL6
C26
C28
C25
C27
C82
D3
R58
R59
C19
C20
C23
C24
2
4
6
B
C
D
E
F

Q1–7,15–19 : 2SC1815(Y) Q8–14,20,22,23 : 2SC1959(Y) Q21 : 2SA733(P) IC1 : MB74LS42M-G
D1–7,10,12,13,18,19,21 : 1S1555 D8,9 : 1N60 D11 : XZ-090 D14 : WZ-120 D15 : 1S1007 D16 : 1S1587 D17 : XZ-055 D20 : XZ-180

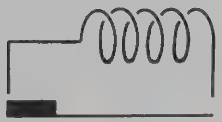
< Attachment method of L27,28 >



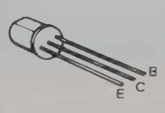
< Attachment method of C2,7,9,15,17,20,35, 45,52,62 >



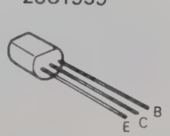
< Attachment method of L2,14,15 >



2SA733

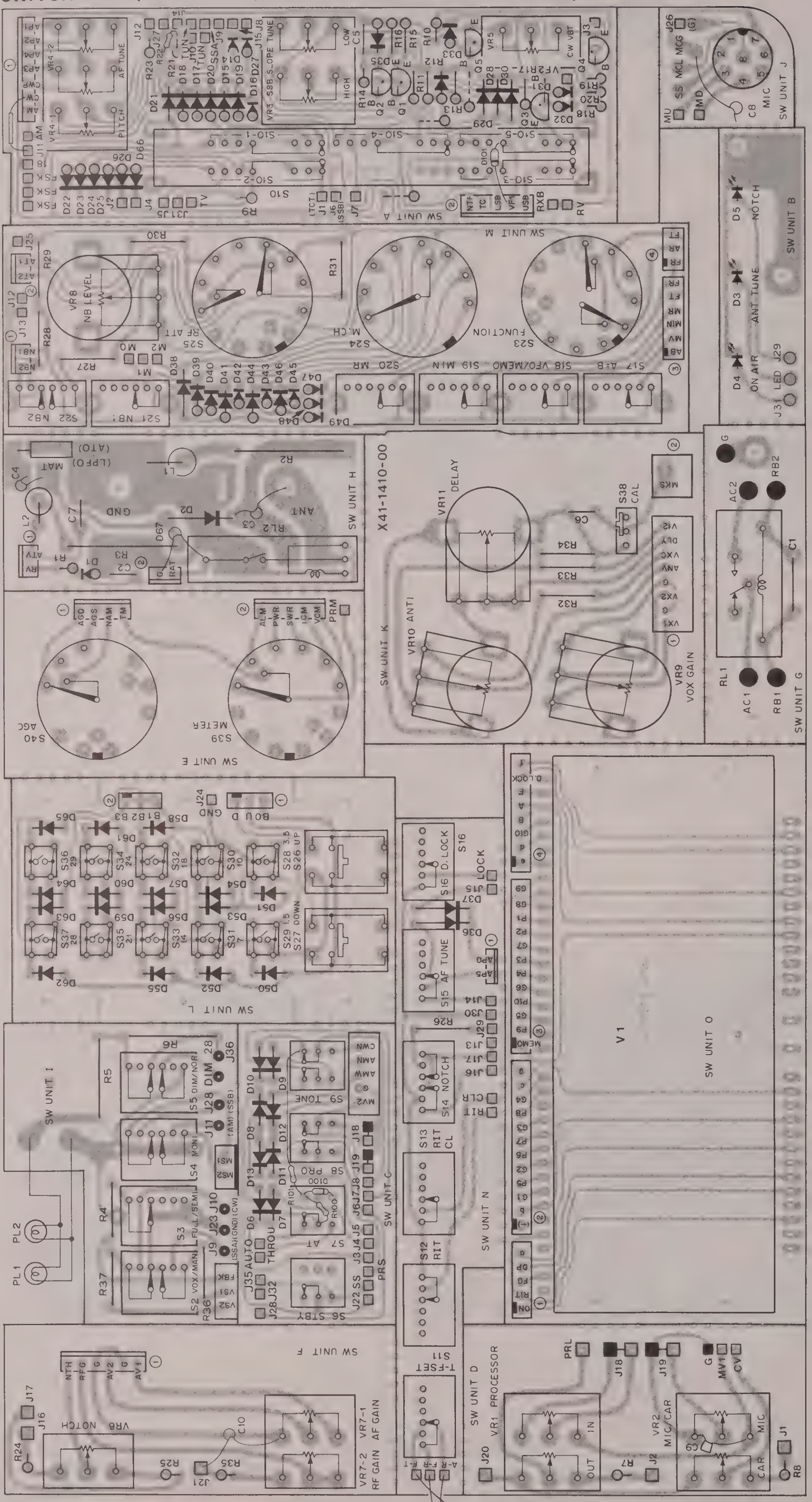


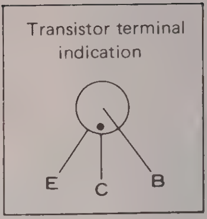
2SC1815
2SC1959



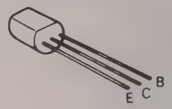
TS-930S PC BOARD VIEW

SWITCH UNIT (X41-1410-00) From S/N 208XXXX–309XXXX Component side view

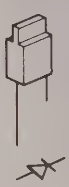

SW UNIT A
SW UNIT J
SW UNIT B
SW UNIT M
SW UNIT H
X41-1410-00
SW UNIT G
SW UNIT K
SW UNIT E
SW UNIT L
SW UNIT I
SW UNIT C
SW UNIT N
SW UNIT O
SW UNIT F
SW UNIT D
VR3 SSB SLOPE TUNE
AF TUNE
PITCH
NOTCH
ANT TUNE
ON AIR
VR8 NB LEVEL
S25 RF ATT
S24 M.CH
S23 FUNCTION
S20 MR
S19 MIN
S18 VFO/MEMO
S17 A=B
S22 NB2
S21 NB1
VR11 DELAY
S38 CAL
VR10 ANTI
VR9 VOX GAIN
S40 AGC
S39 METER
S16 D.LOCK
S15 AF TUNE
S14 NOTCH
S13 RIT CL
S12 RIT
S11 T-FSET
V1
S5 DIM/NOR
S4 MONI
S3 FULL/SEMI
S2 VOX/MAN
S9 TONE
S8 PRO
S7 AT
S6 STBY
PL1
PL2
VR6 NOTCH
VR7-2 RF GAIN
VR7-1 AF GAIN
VR1 PROCESSOR
VR2 MIC/CAR
MIC


Transistor terminal indication
E
C
B

2SA1015
2SC1815



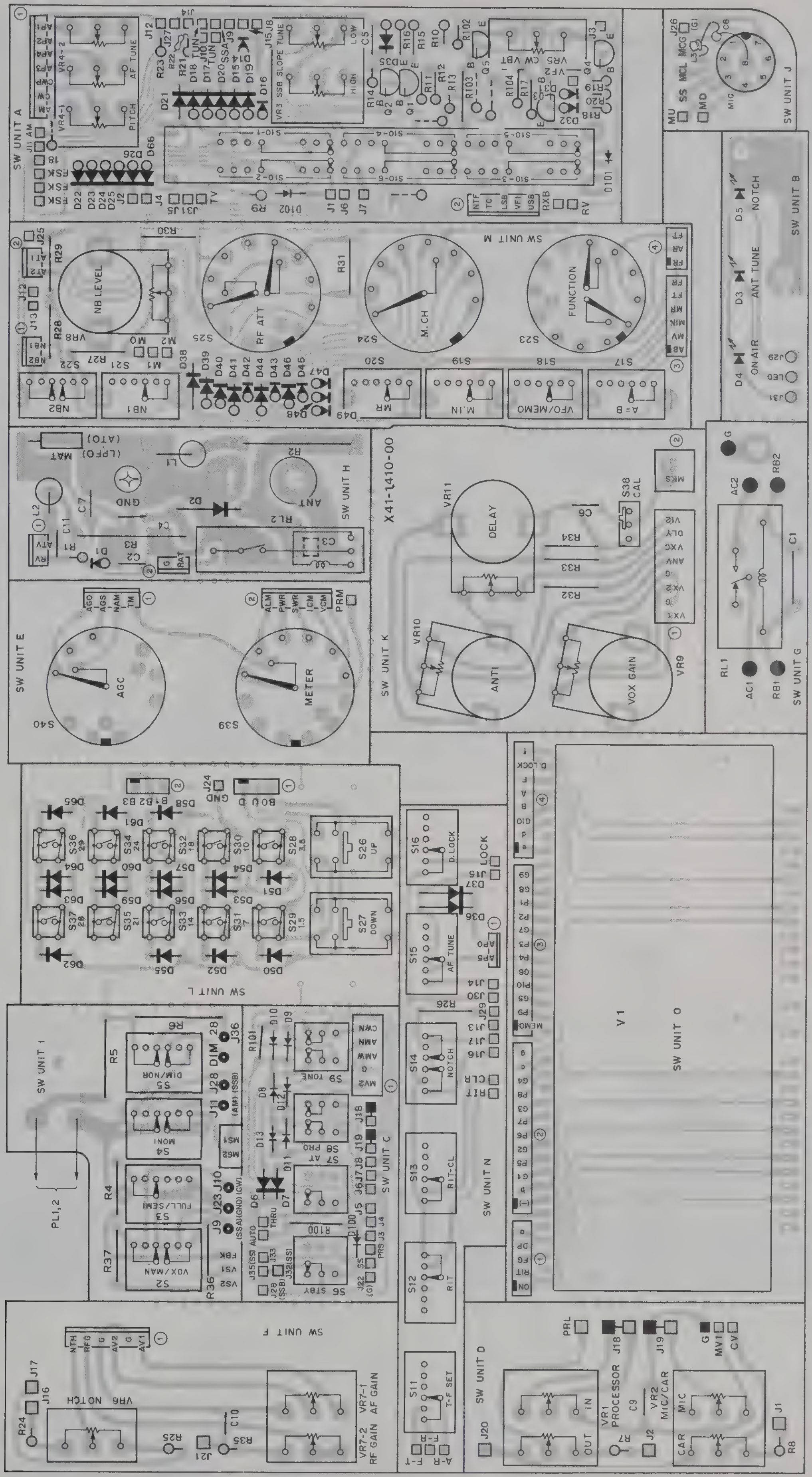
BG5532K
PR5532K



Q1–4 : 2SC1815(Y) Q5 : 2SA1015(Y)
D1,6–34,36–66,100,101 : 1S1555 D2 : GM-3A D3 : BG5532K
D4,5 : PR5532K D35 : XZ-051 D67 : ERZD03DK331 V1 : 11-BT-03Z

SWITCH UNIT (X41-1410-00)

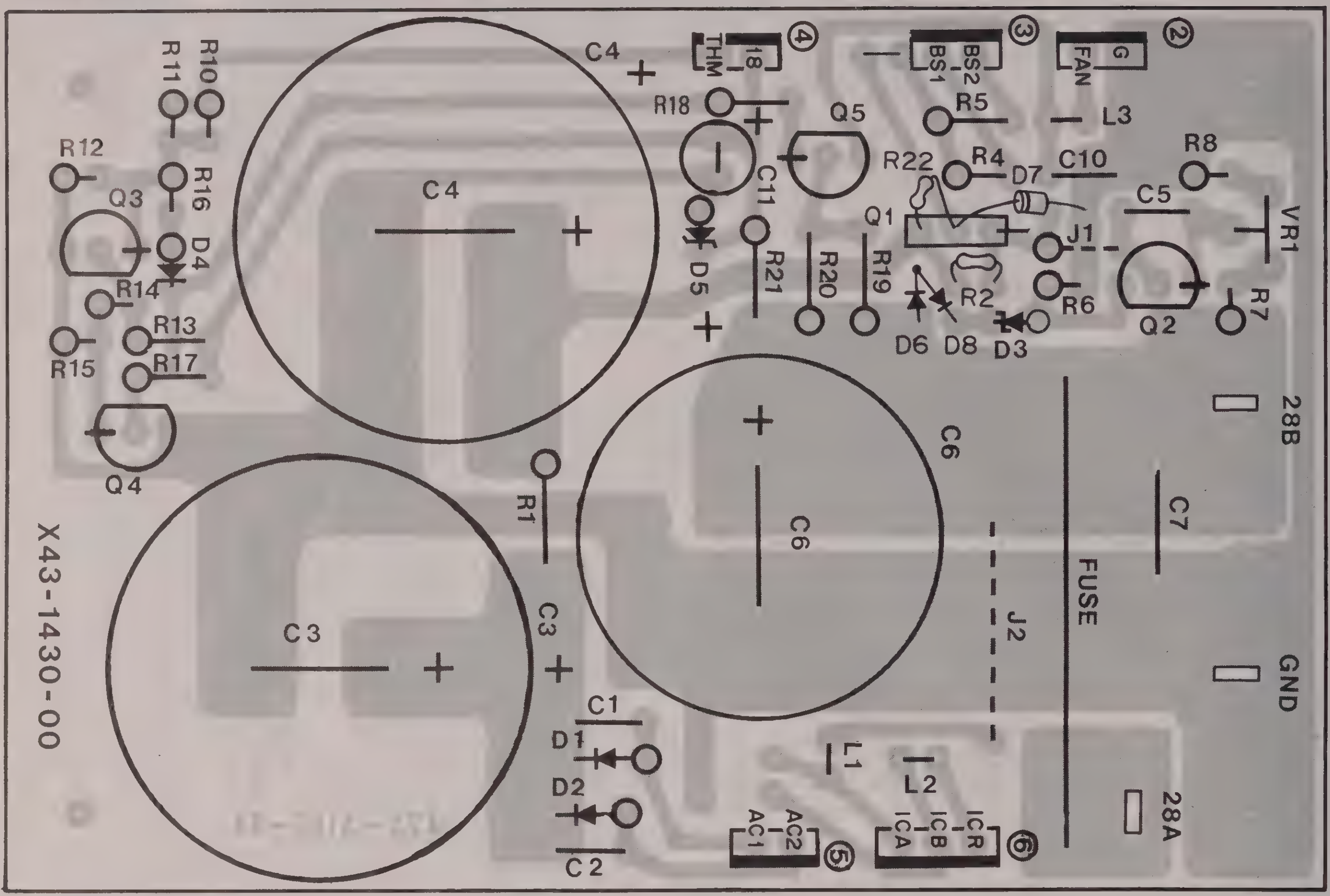
From S/N 310XXXX– Component side view


SW UNIT A
SW UNIT B
SW UNIT C
SW UNIT D
SW UNIT E
SW UNIT F
SW UNIT G
SW UNIT H
SW UNIT I
SW UNIT J
SW UNIT K
SW UNIT L
SW UNIT M
SW UNIT N
SW UNIT O
X41-1410-00
NB LEVEL
RF ATT
M.CH
FUNCTION
AGC
METER
DELAY
ANTI
VOX GAIN
NOTCH
ANT TUNE
ON AIR
VR6 NOTCH
VR7-2 RF GAIN
VR7-1 AF GAIN
VR1 PROCESSOR
VR2 MIC/CAR
V1
PL1,2

Q1–4 : 2SC1815(Y) Q5 : 2SA1015(Y)
D1,6–26,31,32,36–66,100–102 : 1S1555 D2 : GM-3B
D3 : BG5532K D4,5 : PR5532K D35 : XZ-060
D67 : D5A-441LA V1 : 11-BT-03Z

TS-930S PC BOARD VIEWS

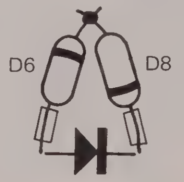
POWER SUPPLY UNIT (X43-1430-00) From S/N 208XXXX–309XXXX Component side view



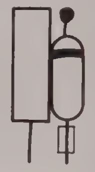
R10
R11
C4
④
THM
18
③
BS2
BS1
②
G
FAN
R12
R16
R18
Q5
R5
L3
R8
Q3
C4
R22
R4
D7
C10
C5
C11
Q1
VR1
D4
J1
D5
R21
R20
R19
R2
R6
R7
R14
D6
D8
D3
Q2
R13
R15
R17
28B
C6
Q4
R1
C6
C7
X43-1430-00
C3
C3
J2
FUSE
GND
C1
D1
L1
L2
D2
28A
AC2
AC1
⑤
ICR
ICB
ICA
⑥
C2

Q1 : 2SA1021(O) Q2–4 : 2SC1815(Y) Q5 : 2SC1959(Y)
D1,2 : V03(C) D3 : XZ-122 D4,6 : 1S1555 D5 : WZ-182 D7 : BZ-320 D8 : SV-03Y

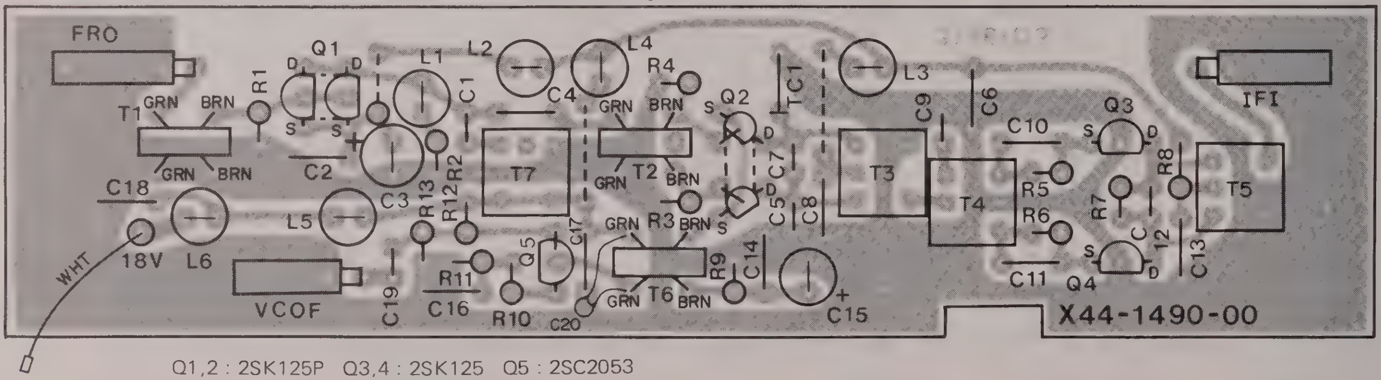
< Attachment method of D6,8 >



< Attachment method of Q1,D6,8 >



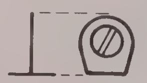
RF UNIT (X44-1490-00) From S/N 208XXXX–309XXXX Component side view



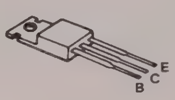
FRO
Q1
D
D
L1
L2
L4
R4
TC1
L3
IFI
R1
S
S
C1
C4
Q2
C9
C6
Q3
T1
GRN
BRN
GRN
BRN
S
D
C10
S
D
GRN
BRN
C2
R2
T7
GRN
T2
BRN
C7
T3
R8
T5
C18
L5
C3
R13
R12
C5
C8
R5
T4
R7
D
S
R6
C
12
WHT
18V
L6
Q5
C17
GRN
R3
BRN
C14
S
D
C13
VCOF
C19
R11
C16
R10
C20
GRN
T6
BRN
R9
C15
C11
Q4
X44-1490-00

Q1,2 : 2SK125P Q3,4 : 2SK125 Q5 : 2SC2053

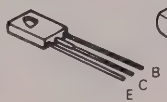
< Attachment method of TC1 >



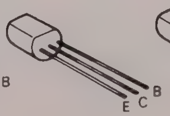
2SB861



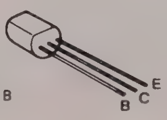
2SA1021



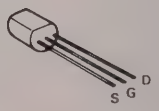
2SC1815
2SC1959
2SC2235



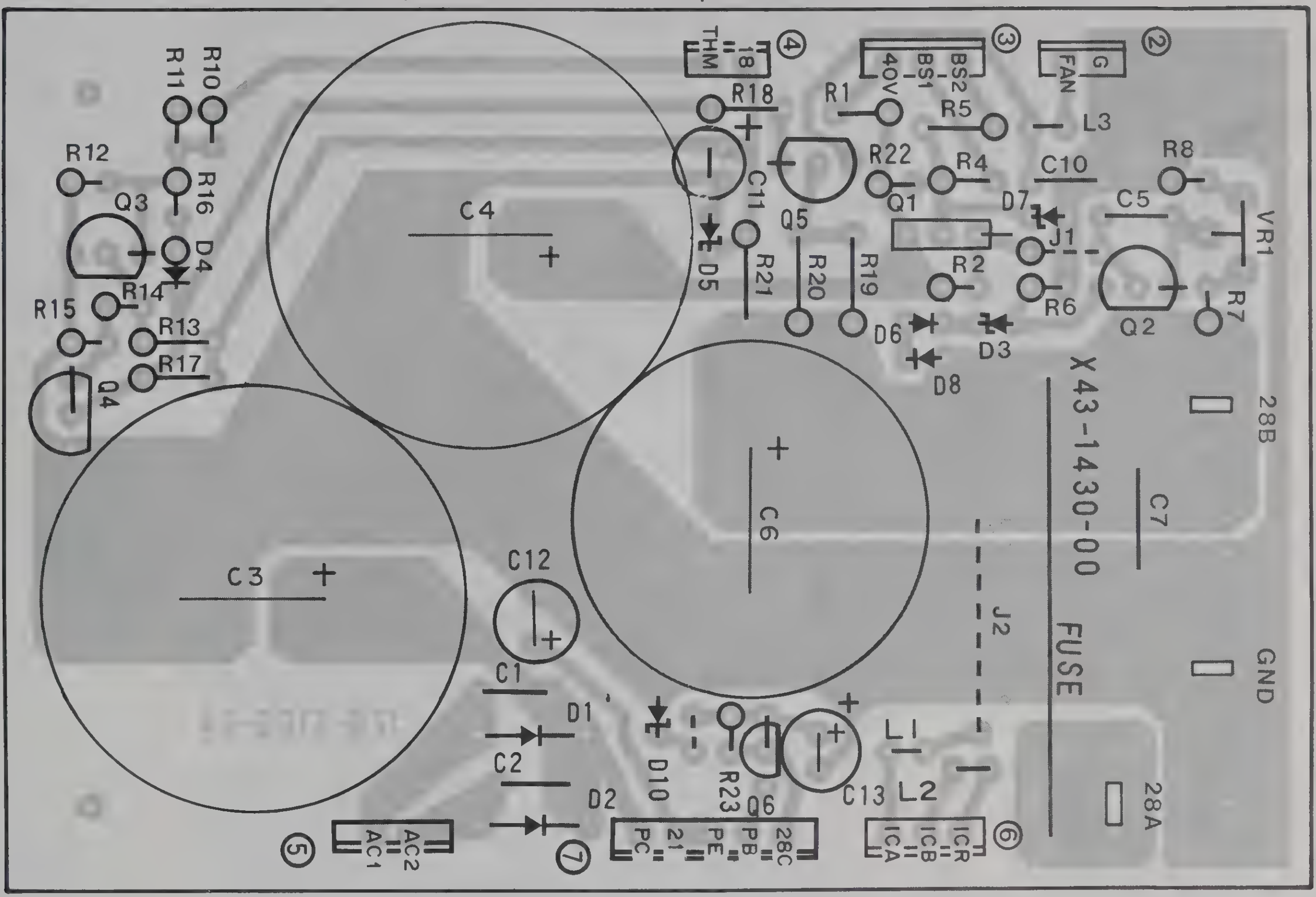
2SC2053



2SK125

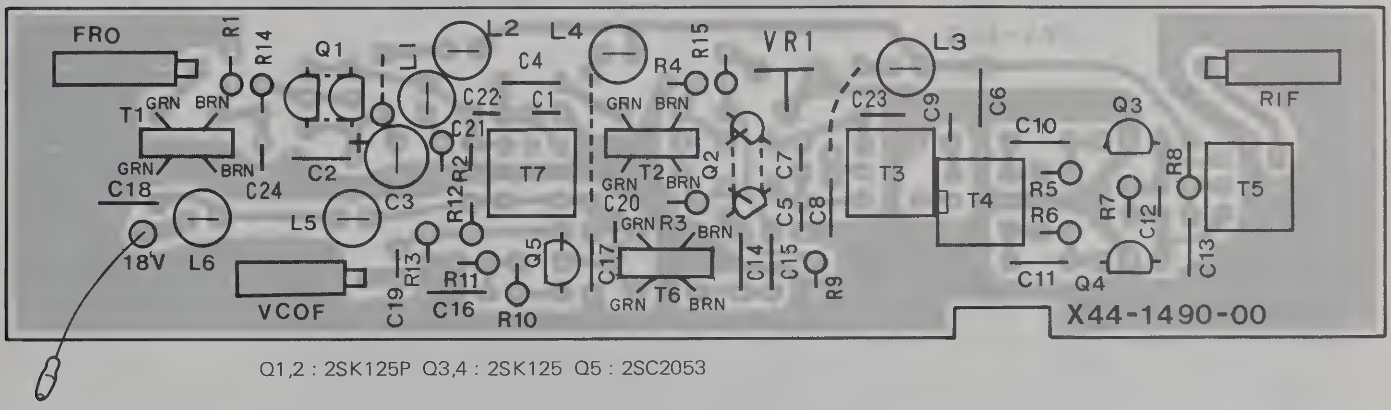


POWER SUPPLY UNIT (X43-1430-00) From S/N 310XXXX– Component side view


R10
R11
R12
R16
Q3
D4
R14
R15
R13
R17
Q4
C4
C3
C12
C1
C2
D1
D2
D10
R23
Q6
C13
L1
L2
THM
18
④
R18
C11
D5
Q5
R21
R20
R19
R1
40V
BS1
BS2
③
R5
R22
R4
Q1
D6
D8
R2
D3
R6
G
FAN
②
L3
C10
R8
C5
D7
J1
VR1
Q2
R7
C6
X43-1430-00
FUSE
J2
C7
28B
GND
28A
AC2
AC1
⑤
⑦
PC
21
PE
PB
28C
ICA
ICB
ICR
⑥

Q1 : 2SB861(C) Q2–4 : 2SC1815(Y) Q5 : 2SC1959(Y) Q6 : 2SC2235(O)
D1,2 : U05B D3 : XZ-122 D4,6 : 1S1555 D5 : WZ-182 D7 : RD33FBD-B1
D8 : SV-03Y D10 : XZ-225

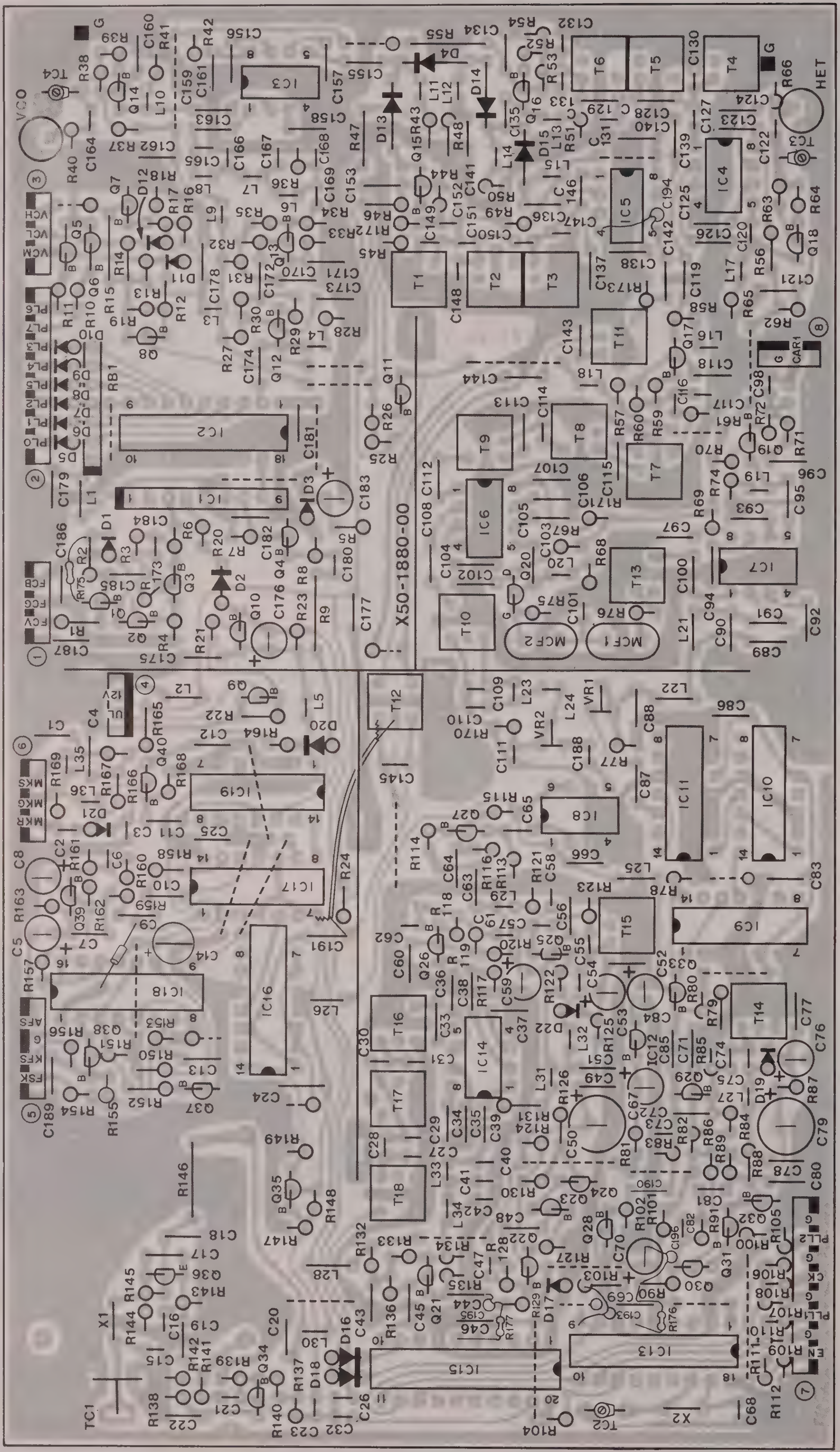
RF UNIT (X44-1490-00) From S/N 310XXXX– Component side view


FRO
R1
R14
Q1
L1
L2
L4
C4
C1
C22
C21
R4
R15
VR1
L3
C23
C9
C6
C10
Q3
R8
RIF
T1
GRN
BRN
C18
C24
C2
C3
R2
T7
T2
Q2
C20
C7
C5
C8
T3
T4
R5
R6
R7
C12
T5
L5
L6
18V
R12
R13
R11
C16
R10
C19
Q5
C17
R3
T6
C14
C15
R9
C11
Q4
C13
VCOF
X44-1490-00

Q1,2 : 2SK125P Q3,4 : 2SK125 Q5 : 2SC2053

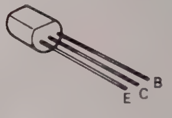
TS-930S PC BOARD VIEW

PLL UNIT (X50-1880-00) Component side view

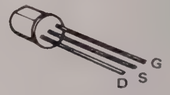


X50-1880-00
VCO
HET
TC1
TC2
TC3
TC4
IC1
IC2
IC3
IC4
IC5
IC6
IC7
IC8
IC9
IC10
IC11
IC13
IC14
IC15
IC16
IC17
IC18
IC19
T1
T2
T3
T4
T5
T6
T7
T8
T9
T10
T11
T12
T13
T14
T15
T16
T17
T18
MCF 1
MCF 2
RB1
CAR1
X1
X2
VR1
VR2
VCH
VCL
VCM
PL0
PL1
PL2
PL3
PL4
PL5
PL6
PL7
FCB
FCG
FCV
UL
12V
MKS
MKG
MKR
AFS
KFS
FSK
PLL
CK
EN
①
②
③
④
⑤
⑥
⑦
⑧
A
C
E
2
4
6

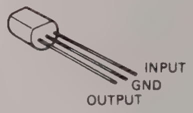
2SA1015
2SC1775
2SC1815
2SC1923



2SK19

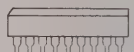


TA78L005AP

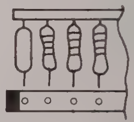


INPUT
GND
OUTPUT

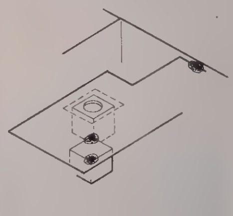
TC5081P



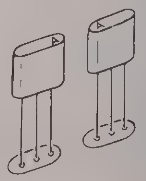
< Attachment direction of RB1 >



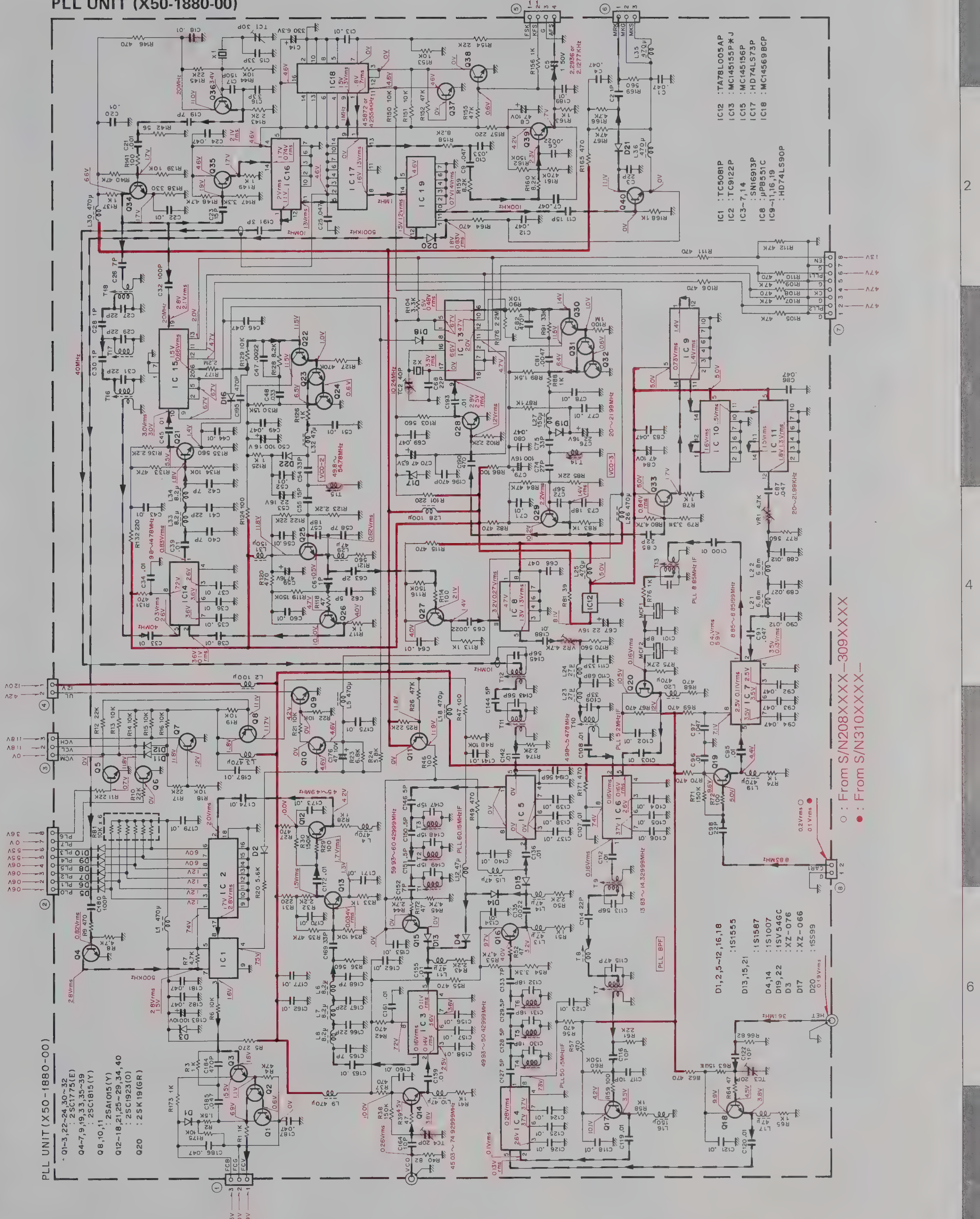
< Attachment method of shield plate >



< Attachment direction of MCF >

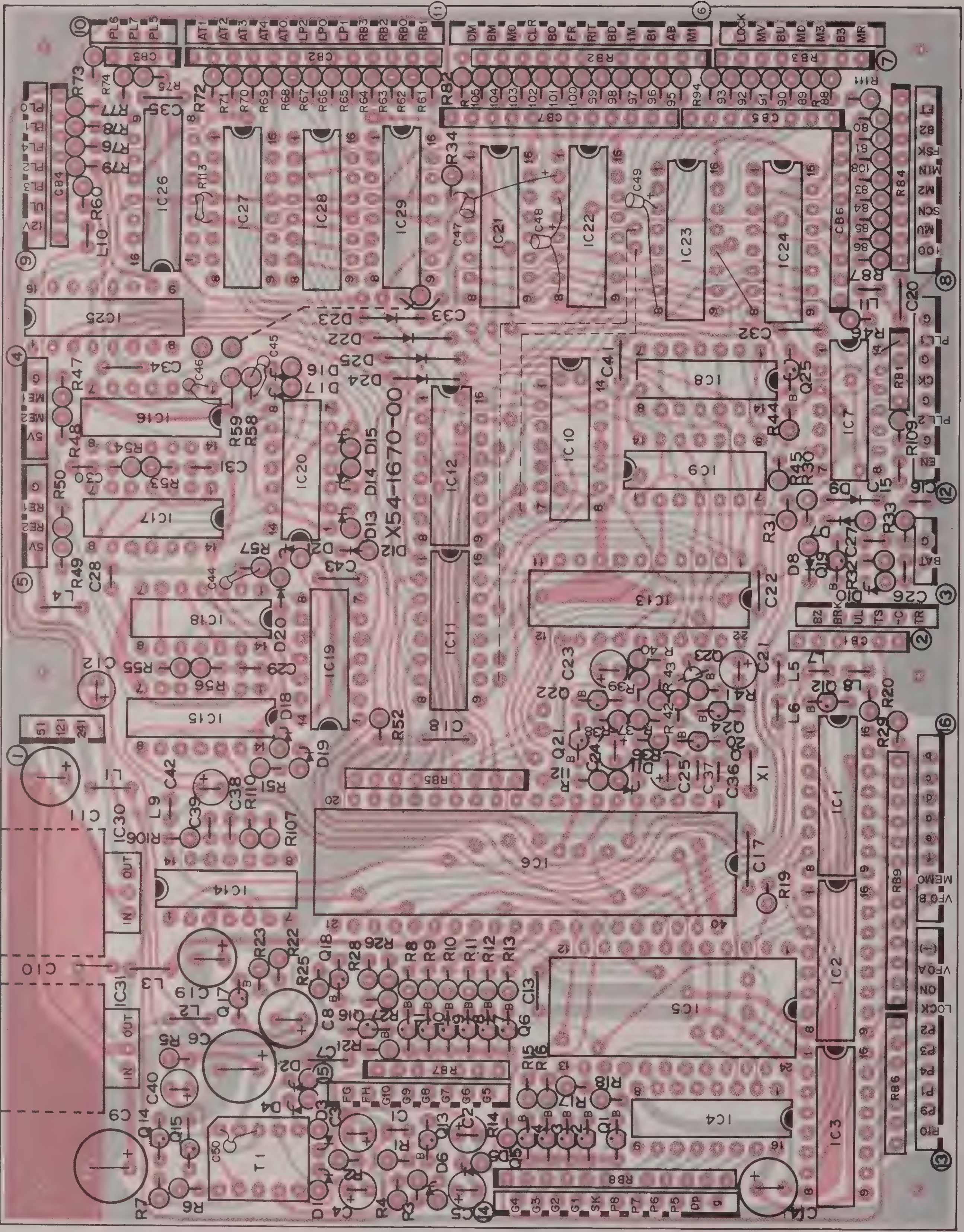


PLL UNIT (X50-1880-00)

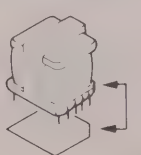

PLL UNIT (X50-1880-00)
Q1~3,22~24,30~32 : 2SC1775(E)
Q4~7,9,19,33,35~39 : 2SC1815(Y)
Q8,10,11 : 2SA1015(Y)
Q12~18,21,25~29,34,40 : 2SC1923(O)
Q20 : 2SK19(GR)
IC1 : TC5081P
IC2 : TC9122P
IC3~7,14 : SN16913P
IC8 : µPB551C
IC9~11,16,19 : HD74LS90P
IC12 : TA78L005AP
IC13 : MC145155P*J
IC15 : MC145156P
IC17 : HD74LS73P
IC18 : MC14569BCP
D1,2,5~12,16,18 : 1S1555
D13,15,21 : 1S1587
D4,14 : 1S1007
D19,22 : 1SV54GC
D3 : XZ-076
D17 : XZ-066
D20 : 1SS99
○ : From S/N208XXXX–309XXXX
● : From S/N310XXXX–
0.2Vrms○ 0.1Vrms●
VCO-1
VCO-2
VCO-3
PLL BPF
HET
VCO
CAR
40MHz
10MHz
500KHz
100KHz
8.83MHz
36.1MHz

TS-930S PC BOARD VIEW

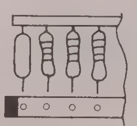
DIGITAL UNIT (X54-1670-00) Component side view


X54-1670-00
IC1
IC2
IC3
IC4
IC5
IC6
IC7
IC8
IC9
IC10
IC11
IC12
IC13
IC14
IC15
IC16
IC17
IC18
IC19
IC20
IC21
IC22
IC23
IC24
IC25
IC26
IC27
IC28
IC29
IC30
IC31
T1
X1
RB1
RB2
RB3
RB4
RB5
RB6
RB7
RB8
RB9
CB1
CB2
CB3
CB4
CB5
CB6
CB7
CB8
AT1
AT2
AT3
AT4
ATO
LP2
LPO
LP1
RB3
RB2
RBO
RB1
DM
BM
MO
CLR
BO
FR
RIT
BD
1M
B1
AB
M1
LOCK
MV
BU
MD
M3
B3
MR
PL6
PL7
PL5
FSK
MIN
M2
SCN
MU
100
PLL1
PLL2
EN
BAT
BZ
BRK
UL
TS
TR
VFO B
MEMO
VFOA
ON
LOCK
P2
P3
P4
P1
P9
P10
G4
G3
G2
G1
SK
P8
P7
P6
P5
DP
FG
FH
G10
G9
G8
G7
G6
G5
IN
OUT
12V
5V

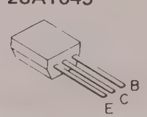
< Attachment direction of T1>



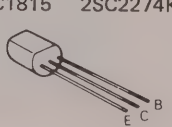
< Attachment direction of RB,CB >



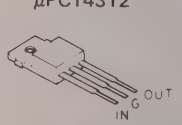
2SA1049



2SA984K 2SC1923
2SA1015 2SC1959
2SC1815 2SC2274K

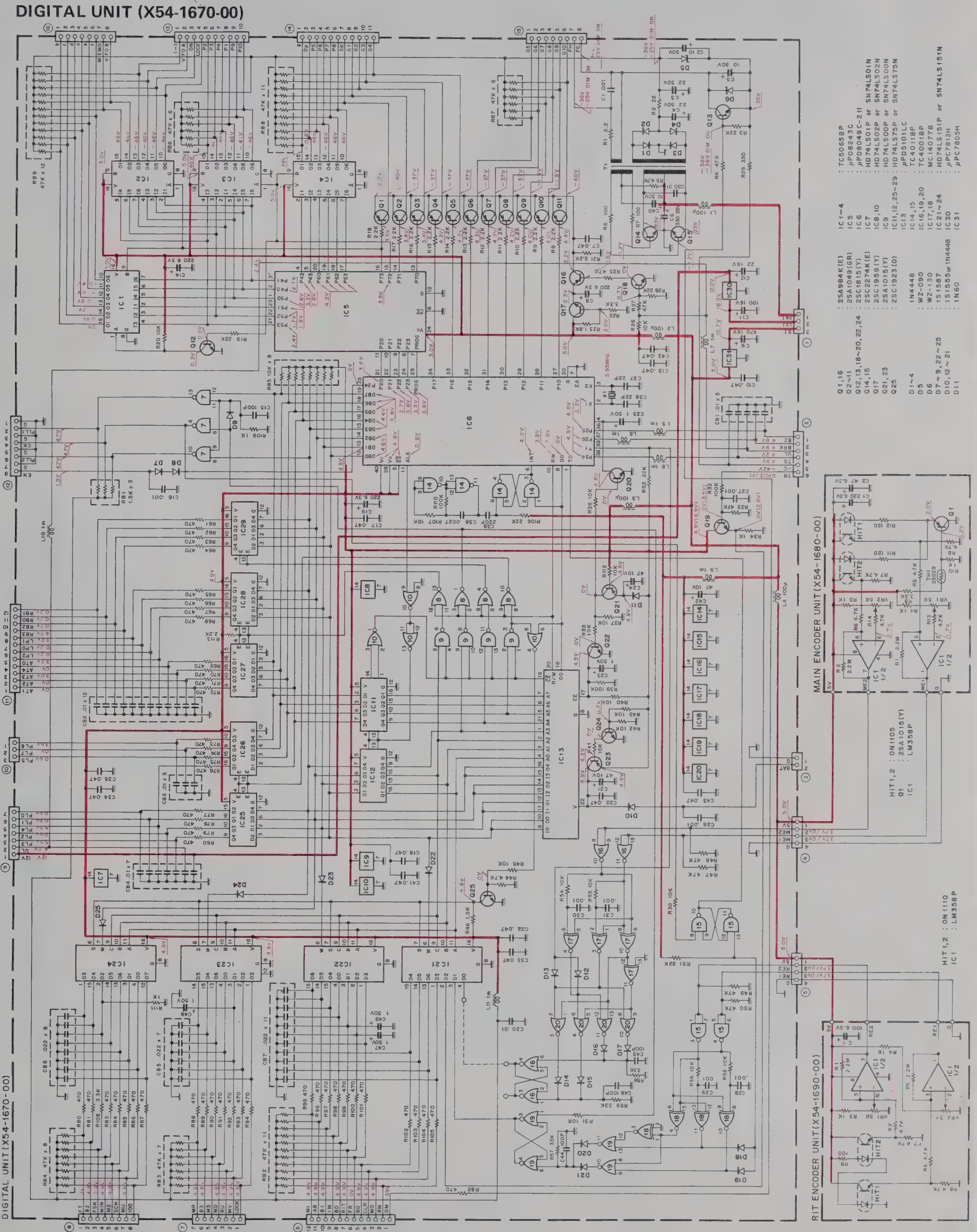


µPC14305
µPC14312



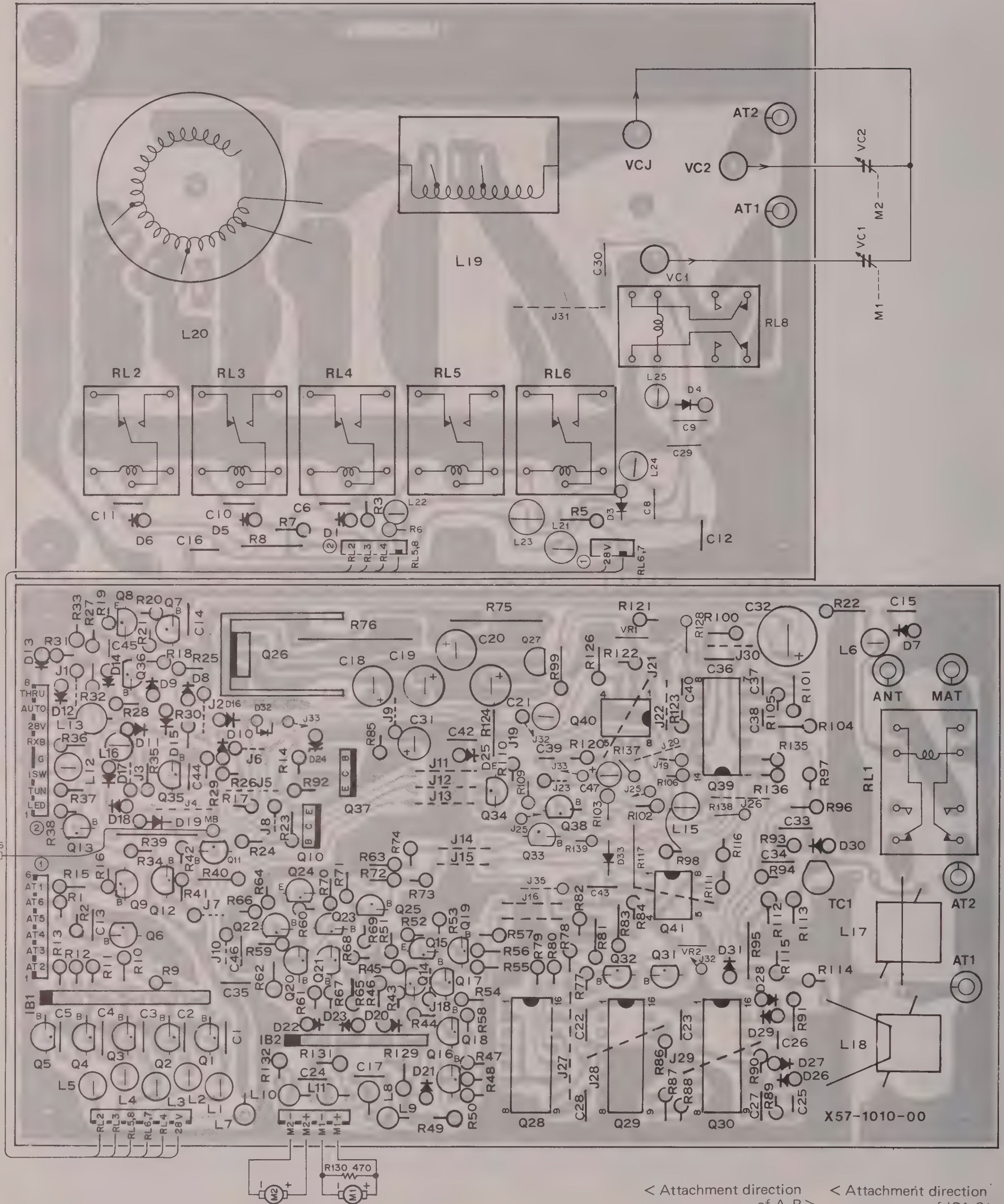
CIRCUIT DIAGRAM TS-930S

Note: Data transfer from IC21–24 only occurs when the latch signal on "S" & "W" are vertically aligned (in phase).

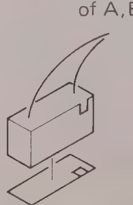

DIGITAL UNIT (X54-1670-00)
MAIN ENCODER UNIT (X54-1680-00)
RIT ENCODER UNIT (X54-1690-00)
IC1~4 : TC5065BP
IC5 : μPD8243C
IC6 : μPD8049C-211
IC7 : HD74LS01P or SN74LS01N
IC8,10 : HD74LS02P or SN74LS02N
IC9 : HD74LS00P or SN74LS00N
IC11,12,25~29 : HD74LS75P or SN74LS75N
IC13 : μPD5101LC
IC14,15 : TC4011BP
IC16,19,20 : TC4001BP
IC17,18 : MC14077B
IC21~24 : HD74LS151P or SN74LS151N
IC30 : μPC7812H
IC31 : μPC7805H
Q1,16 : 2SA984K(E)
Q2~11 : 2SA1049(GR)
Q12,13,18~20,22,24 : 2SC1815(Y)
Q14,15 : 2SC2274K(E)
Q17 : 2SC1959(Y)
Q21,23 : 2SA1015(Y)
Q25 : 2SC1923(O)
D1~4 : 1N4448
D5 : WZ-090
D6 : WZ-130
D7~9,22~25 : 1S1587
D10,12~21 : 1S1555 or 1N4448
D11 : 1N60
HIT1,2 : ON1105
Q1 : 2SA1015(Y)
IC1 : LM358P
HIT1,2 : ON1110
IC1 : LM358P

TS-930S PC BOARD VIEW

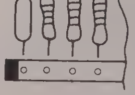
AT UNIT (X57-1010-00) Component side view


AT2
VCJ
VC2
AT1
VC1
M2
M1
L19
L20
C30
J31
RL8
RL2
RL3
RL4
RL5
RL6
L25
D4
C9
C29
L24
C8
C12
C11
D6
C10
D5
C16
R8
R7
C6
D1
R3
L22
R6
R5
D3
L21
L23
RL2 RL3 RL4 RL5,8
28V RL6,7
R33
R27
R19
Q8
R20
Q7
C14
R76
R75
Q26
C20
Q27
C18
C19
R99
R121
VR1
R126
R122
J21
R128
R100
C32
J30
C36
R22
C15
L6
D7
ANT
MAT
D13
R31
C45
Q36
R18
R25
D14
D8
D9
J1
THRU
AUTO
28V
RXB
G
ISW
TUN
LED
D12
R32
L13
R28
R30
J2
D16
D32
J33
D10
D11
R36
L16
L12
D17
J3
R35
D15
C44
J6
R14
D24
Q37
R85
J9
C31
C42
R124
D25
C21
J19
Q40
R120
J22
R123
C40
C37
R101
R105
C38
R104
R135
RL1
R37
Q35
J4
R29
R26
J5
R92
R17
J11
J12
J13
R110
R109
Q34
C39
J32
J33
C47
R137
J20
J19
R106
Q39
R136
R97
R96
D18
D19
MB
R38
Q13
J8
R23
Q10
R39
R34
R42
Q11
R24
Q38
R103
R102
J25
J23
L15
J26
R138
C33
R93
D30
NO.6
R15
R16
R1
R2
Q9
Q12
R41
R40
R64
R66
J7
Q24
R70
R71
R63
R72
R73
R74
J14
J15
Q33
R139
D33
R117
R98
R116
C34
R94
TC1
AT2
AT1
AT6
AT5
AT4
AT3
R13
C13
Q6
R12
R11
R10
R9
Q22
R60
Q23
Q25
R52
R53
Q19
R69
R51
R68
J35
J16
C43
R82
R111
R83
R84
Q41
R112
R113
L17
J10
C46
R59
R62
Q20
Q21
Q15
R57
R56
R55
R79
R80
R78
R81
Q32
Q31
VR2
J32
D31
R95
R115
R114
C35
R45
R46
R65
R61
R67
R43
Q14
Q17
R54
D28
IB1
C5
C4
C3
C2
C1
D23
D20
J18
R58
C22
C23
D29
R91
IB2
D22
R44
Q18
C26
L18
Q5
Q4
Q3
Q2
Q1
R131
R129
Q16
R47
R132
C24
C17
D21
R48
J27
J28
R86
J29
R90
D27
D26
L5
L4
L3
L2
L1
L10
L11
L8
L9
R87
R88
R89
C25
C27
L7
R49
R50
C28
Q28
Q29
Q30
X57-1010-00
RL2 RL3 RL5,8 RL6,7 RL4 28V
M2- M2+ M1- M1+
R130 470
M2
M1

< Attachment direction of A,B >

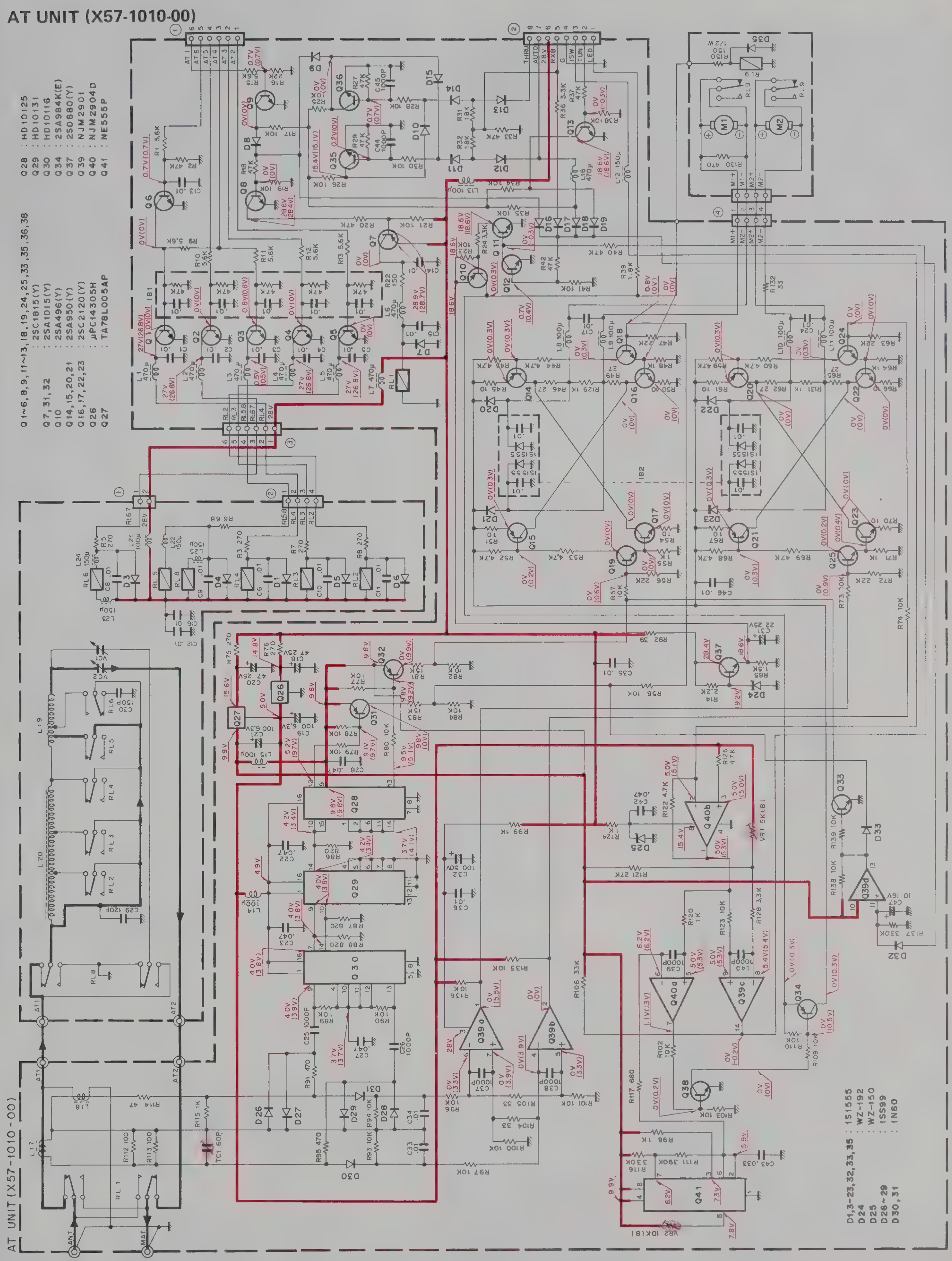


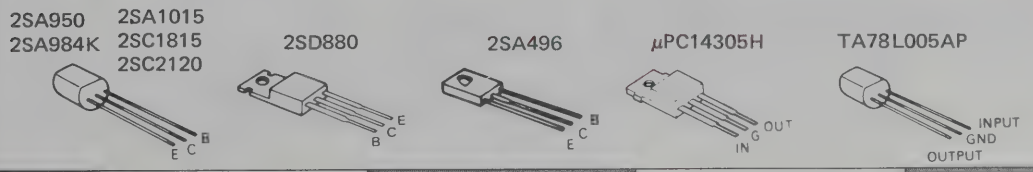
< Attachment direction of IB1,2 >



CIRCUIT DIAGRAM TS-930S

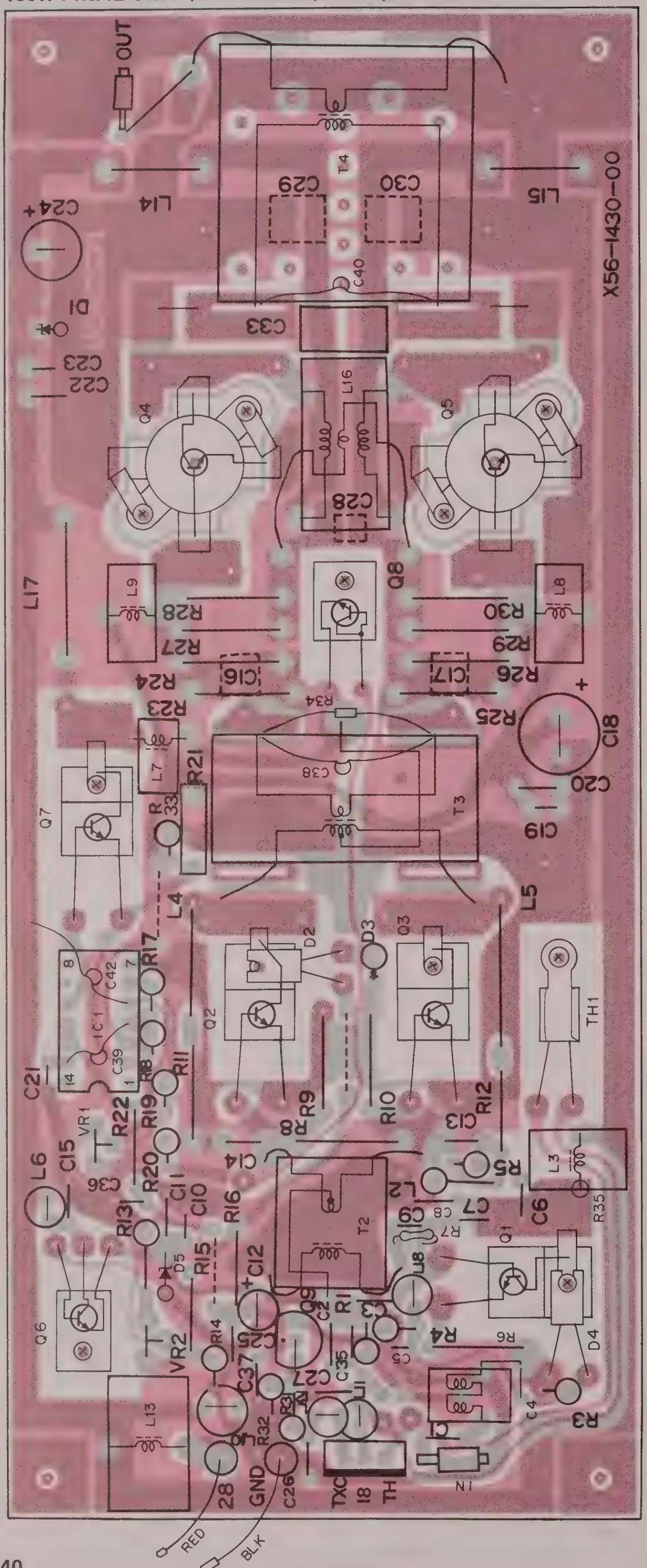
AT UNIT (X57-1010-00)


Q1~6,8,9,11~13,18,19,24,25,33,35,36,38 : 2SC1815(Y)
Q7,31,32 : 2SA1015(Y)
Q10 : 2SA496(Y)
Q14,15,20,21 : 2SA950(Y)
Q16,17,22,23 : 2SC2120(Y)
Q26 : µPC14305H
Q27 : TA78L005AP
Q28 : HD10125
Q29 : HD10131
Q30 : HD10116
Q34 : 2SA984K(E)
Q37 : 2SD880(Y)
Q39 : NJM2901
Q40 : NJM2904D
Q41 : NE555P
D1,3~23,32,33,35 : 1S1555
D24 : WZ-192
D25 : WZ-150
D26~29 : 1SS99
D30,31 : 1N60
AT UNIT (X57-1010-00)
ANT
MAT
AT1
AT2
THRU
AUTO
28V
RXB
G
TSW
TUN
LED
M1
M2
RL1
RL2
RL3
RL4
RL5
RL6
RL7
RL8
RL9
L19
L20
VC1
VC2
TC1 60P
VR1 5K(B)
VR2 10K(B)


2SA950
2SA984K
2SA1015
2SC1815
2SC2120
E C B
2SD880
B C E
2SA496
E C B
µPC14305H
IN G OUT
TA78L005AP
INPUT
GND
OUTPUT

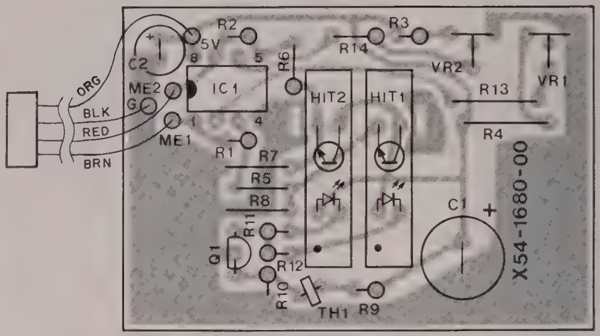
TS-930S PC BOARD VIEWS

100W FINAL UNIT (X56-1430-00) **Component side view**


OUT
L14
L15
T4
C29
C30
C24
C40
X56-1430-00
D1
C33
C23
C22
L16
Q4
Q5
C28
L17
L9
L8
Q8
R28
R30
R27
R29
R24
C16
C17
R26
R34
R23
R25
C18
L7
R21
C38
C20
Q7
R33
T3
C19
L4
L5
D2
D3
Q3
C42
R17
IC1
C39
Q2
TH1
C21
R18
R11
VR1
R22
R19
R9
R10
R12
C13
R8
L6
C15
R20
C14
R5
L3
C36
C11
C10
R16
L2
C7
C6
R35
R13
C9
C8
R7
T2
Q1
D5
R15
C12
U8
Q6
R14
Q9
R1
C34
C2
R4
R6
VR2
C25
C35
C5
D4
C37
C27
L1
L13
R32
R3
C4
R3
D6
C1
28
GND
C26
TXC
18
TH
N1
RED
BLK

MAIN ENCODER UNIT (X54-1680-00)

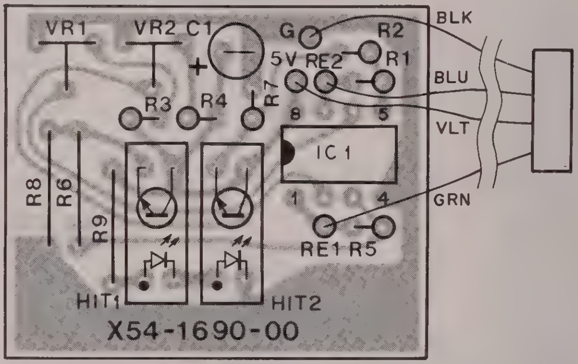
Component side view


R2
R3
5V
R14
R6
8
5
C2
IC1
VR2
R13
VR1
ORG
ME2
HIT2
HIT1
G
BLK
RED
ME1
1
4
R4
BRN
R1
R7
X54-1680-00
R5
R8
C1
R11
Q1
R12
R10
TH1
R9

HIT1,2 : ON1105 Q1 : 2SA1015(Y) IC1 : LM358P

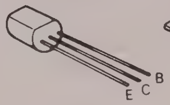
RIT ENCODER UNIT (X54-1690-00)

Component side view

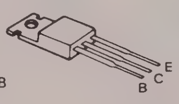

VR1
VR2
C1
G
R2
BLK
5V
RE2
R1
BLU
R7
R3
R4
8
5
VLT
IC1
R8
R6
1
4
GRN
R9
RE1
R5
HIT1
HIT2
X54-1690-00

HIT1,2 : ON1110 IC1 : LM358P

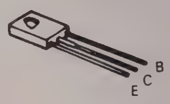
2SA1015
2SC1959



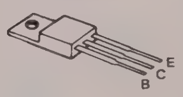
2SC2075
2SD880



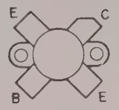
2SC496



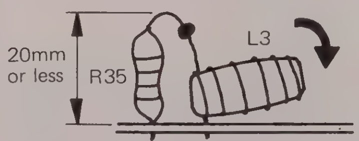
MRF485



MRF422



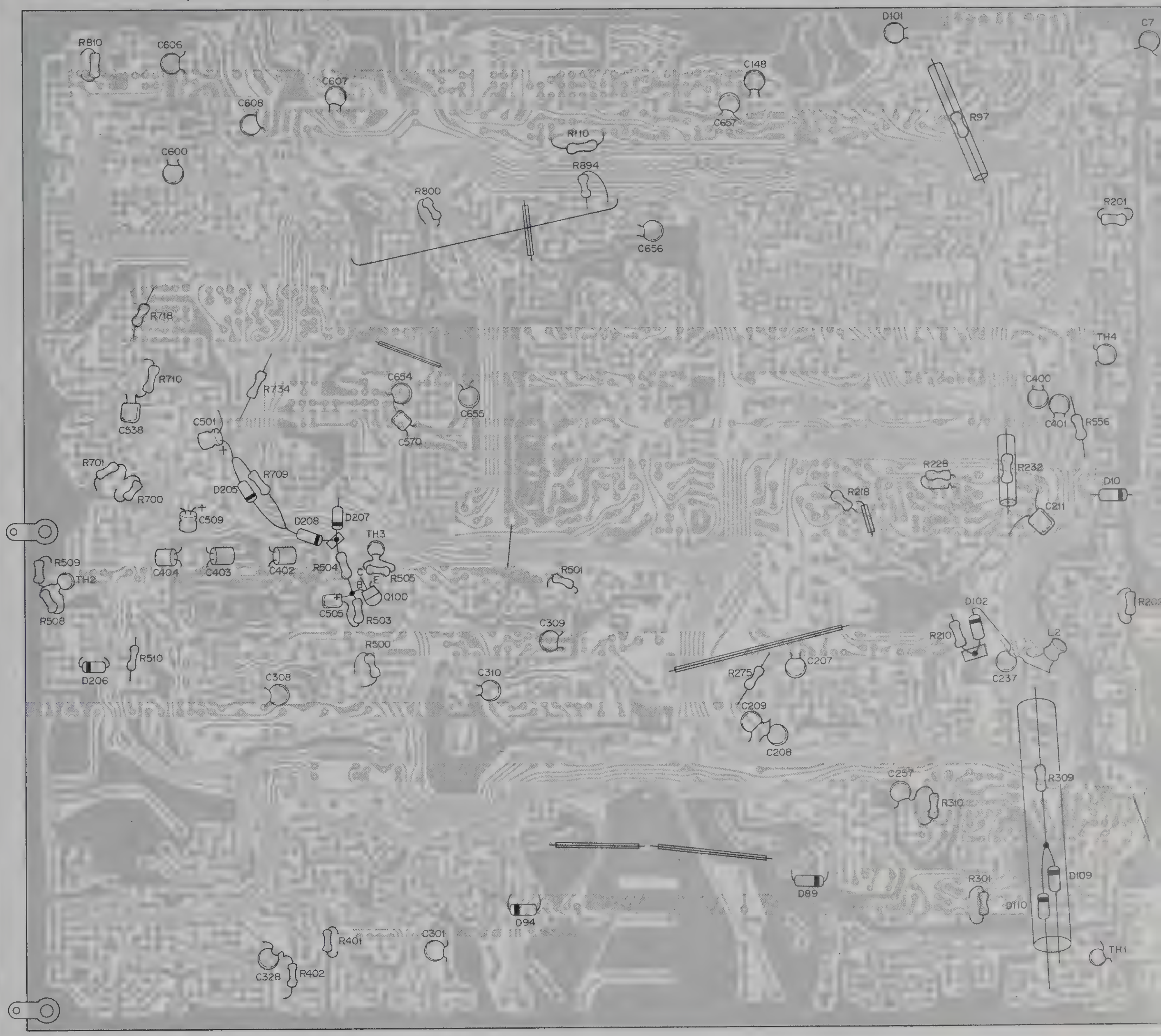
< Attachment method of R35 and L3 >


20mm
or less
R35
L3

Q1 : 2SC2075 Q2,3 : MRF485 Q4,5 : MRF422
Q6,8 : 2SC496(Y) Q7 : 2SD880(Y) Q9 : 2SC1959(Y)
IC1 : MC1723CL
D1 : BZ-350 D2,4 : STV3H(O) D3 : 1S1555 D5 : BZ-192

TS-930S PC BOARD VIEWS

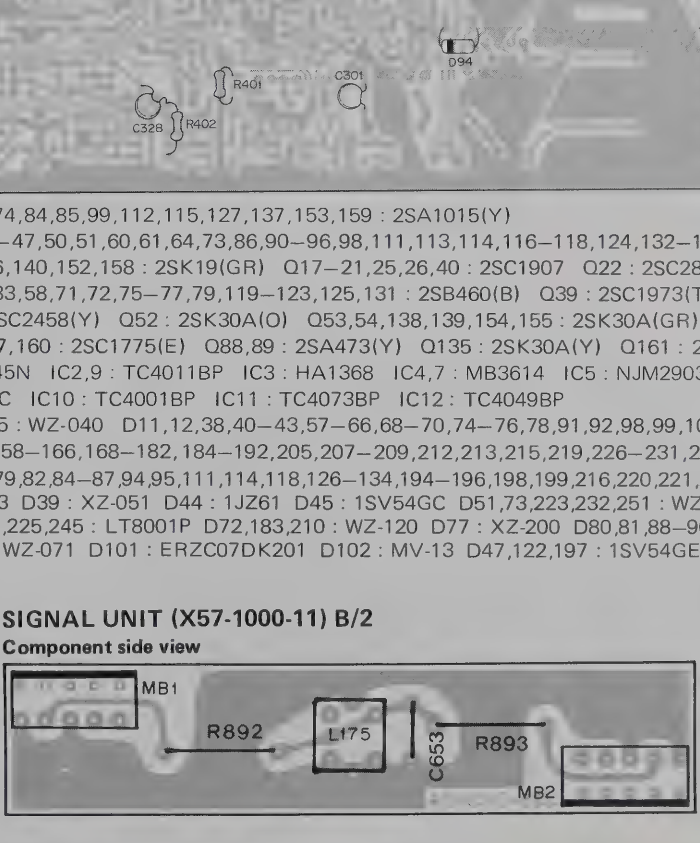
SIGNAL UNIT (X57-1000-11) A/2 **From S/N208XXXX–309XXXX Foil side view**


D101
C7
R810
C606
C148
C607
C608
C657
R97
R110
C600
R894
R800
R201
C656
R718
TH4
R710
R734
C654
C400
C655
C538
C501
C570
C401
R556
R701
R709
R228
R232
D10
D205
R218
R700
C509
D207
C211
D208
TH3
R509
TH2
C404
C403
C402
R504
R505
R501
B
E
Q100
D102
C505
R503
R508
C309
R210
L2
R500
R510
C207
C237
D206
C308
C310
R275
C209
C208
C257
R309
R310
D109
R301
D89
D94
D110
R401
C301
TH1
C328
R402

Q11,12,24,31,74,84,85,99,112,115,127,137,153,159 : 2SA1015(Y)
Q13,34–38,44–47,50,51,60,61,64,73,86,90–96,98,111,113,114,116–118,124,132–134,136,141–145,148–151,156,157,162 : 2SC1815(Y)
Q14–16,28,126,140,152,158 : 2SK19(GR) Q17–21,25,26,40 : 2SC1907 Q22 : 2SC2899 Q23 : 2SA984K(E)
Q27,29,30,32,33,58,71,72,75–77,79,119–123,125,131 : 2SB460(B) Q39 : 2SC1973(T) Q41–43,55–57,59,65–80,78,80,87,128–130 : 3SK
Q48,49,100 : 2SC2458(Y) Q52 : 2SK30A(O) Q53,54,138,139,154,155 : 2SK30A(GR) Q62,63 : 2SK125 Q81 : 2SC2086
Q82,83,146,147,160 : 2SC1775(E) Q88,89 : 2SA473(Y) Q135 : 2SK30A(Y) Q161 : 2SD880(Y)
IC1 : SN74LS145N IC2,9 : TC4011BP IC3 : HA1368 IC4,7 : MB3614 IC5 : NJM2903D IC6 : TA7302P
IC8 : UA7818UC IC10 : TC4001BP IC11 : TC4073BP IC12 : TC4049BP
D10,71,125,205 : WZ-040 D11,12,38,40–43,57–66,68–70,74–76,78,91,92,98,99,108–110,112,113,116,117,119,121,123,124,135–138,1
149,154–156,158–166,168–182,184–192,205,207–209,212,213,215,219,226–231,234–237,242,243,246–250 : 1S1555 or 1N4448
D13,14,48–50,79,82,84–87,94,95,111,114,118,126–134,194–196,198,199,216,220,221,233 : 1S1587 D15–33 : 1S2588 D34,35 : BA379
D36,37 : XZ-033 D39 : XZ-051 D44 : 1JZ61 D45 : 1SV54GC D51,73,223,232,251 : WZ-150 D52–55,238–241 : 1N60
D56,67,120,222,225,245 : LT8001P D72,183,210 : WZ-120 D77 : XZ-200 D80,81,88–90,93,96,97 : 1S1007 D83,167 : WZ-090
D100,115,224 : WZ-071 D101 : ERZC07DK201 D102 : MV-13 D47,122,197 : 1SV54GE D140 : ND487R1-3R D148 : WZ-061 D217,244 : FC6

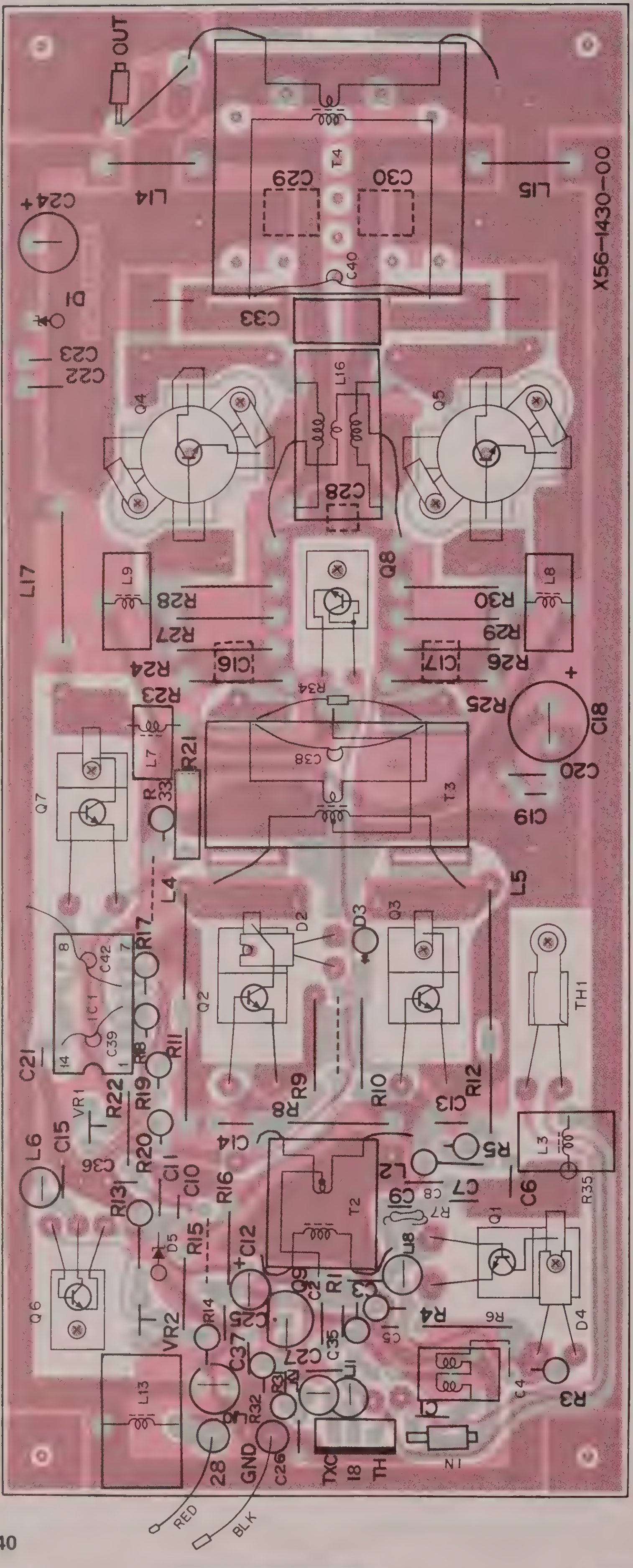
SIGNAL UNIT (X57-1000-11) B/2

Component side view


MB1
R892
L175
C653
R893
MB2

TS-930S PC BOARD VIEWS

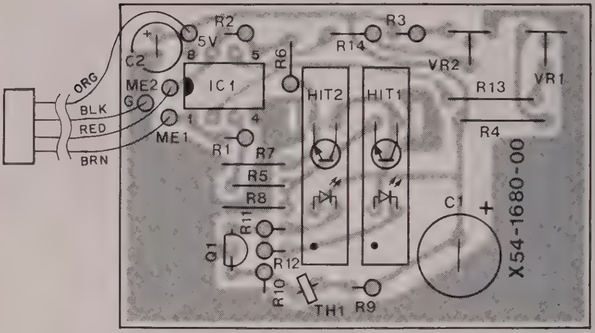
100W FINAL UNIT (X56-1430-00) **Component side view**


OUT
L14
L15
T4
C29
C30
C40
X56-1430-00
C24
D1
C33
C23
C22
L16
Q4
Q5
C28
L17
Q8
L9
L8
R28
R30
R27
R29
R24
R26
C16
C17
R34
R23
R25
C18
L7
R21
C38
T3
C20
Q7
R33
C19
L4
L5
D2
D3
Q3
IC1
C42
R17
Q2
TH1
C39
R8
R11
C21
VR1
R22
R19
R9
R10
R12
C13
L6
C15
R20
C14
R5
L3
C36
C11
C10
R16
L2
C9
C8
C7
C6
R35
R13
D5
R15
C12
T2
R7
Q1
Q9
C2
R1
C3
Q6
VR2
R14
C25
R4
R6
D4
C37
C27
C35
L1
C5
C4
L13
R31
R32
C1
R3
28
GND
C26
TXC
18
TH
N1
RED
BLK

Q1 : 2SC2075 Q2,3 : MRF485 Q4,5 : MRF422
Q6,8 : 2SC496(Y) Q7 : 2SD880(Y) Q9 : 2SC1959(Y)
IC1 : MC1723CL
D1 : BZ-350 D2,4 : STV3H(O) D3 : 1S1555 D5 : BZ-192

MAIN ENCODER UNIT (X54-1680-00)

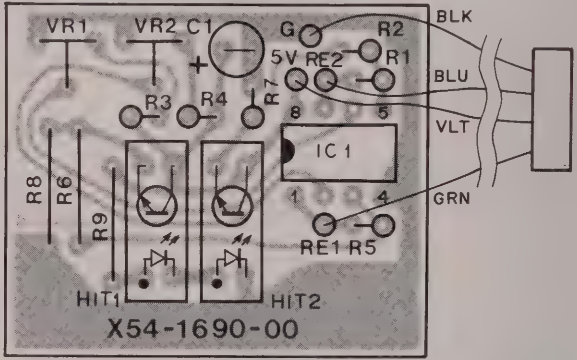
Component side view


ORG
BLK
RED
BRN
C2
5V
R2
8
5
R6
R3
R14
VR2
VR1
ME2
G
IC1
HIT2
HIT1
R13
ME1
1
4
R1
R7
R5
R8
R4
R11
Q1
R12
R10
TH1
R9
C1
X54-1680-00

HIT1,2 : ON1105 Q1 : 2SA1015(Y) IC1 : LM358P

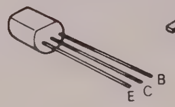
RIT ENCODER UNIT (X54-1690-00)

Component side view

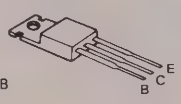

VR1
VR2
C1
G
R2
BLK
5V
RE2
R1
BLU
R7
R3
R4
8
5
VLT
IC1
R8
R6
1
4
GRN
R9
RE1
R5
HIT1
HIT2
X54-1690-00

HIT1,2 : ON1110 IC1 : LM358P

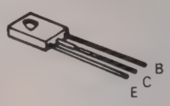
2SA1015
2SC1959



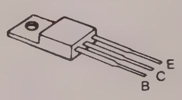
2SC2075
2SD880



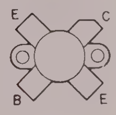
2SC496



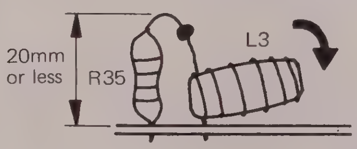
MRF485



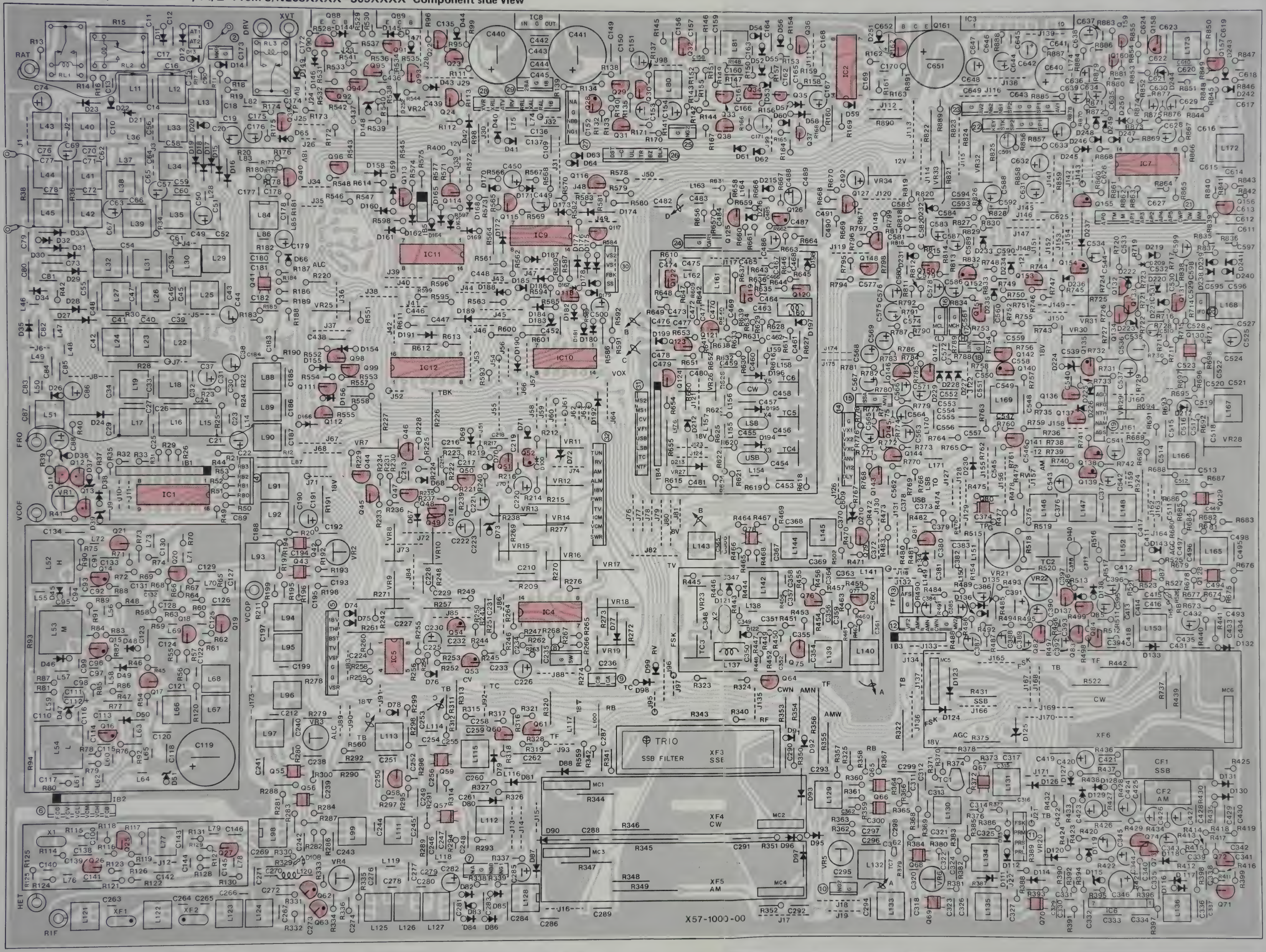
MRF422



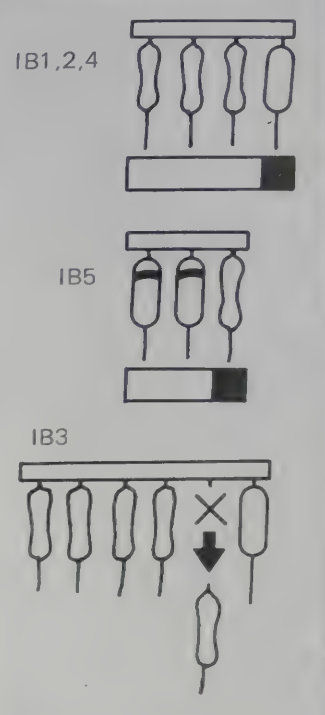
< Attachment method of R35 and L3 >


20mm
or less
R35
L3

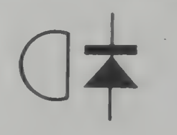
SIGNAL UNIT (X57-1000-11) A/2 From S/N208XXXX–309XXXX Component side view


TRIO SSB FILTER
XF3 SSB
XF4 CW
XF5 AM
XF6
CF1 SSB
CF2 AM
X57-1000-00
IC1
IC2
IC3
IC4
IC5
IC6
IC7
IC8
IC9
IC10
IC11
IC12
IB1
IB2
IB3
IB4
IB5
RAT
XVT
DRV
FRO
VCOF
VCOP
HET
R1F
VOX
TBK
ALC
FSK
TB
CW
SSB
AM
B
D
F
2
4
6

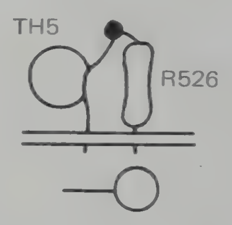
< Attachment direction of IB >


IB1,2,4
IB5
IB3

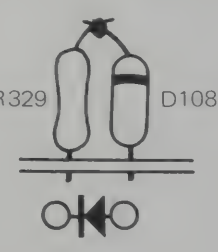
< Attachment direction of D217,244 >

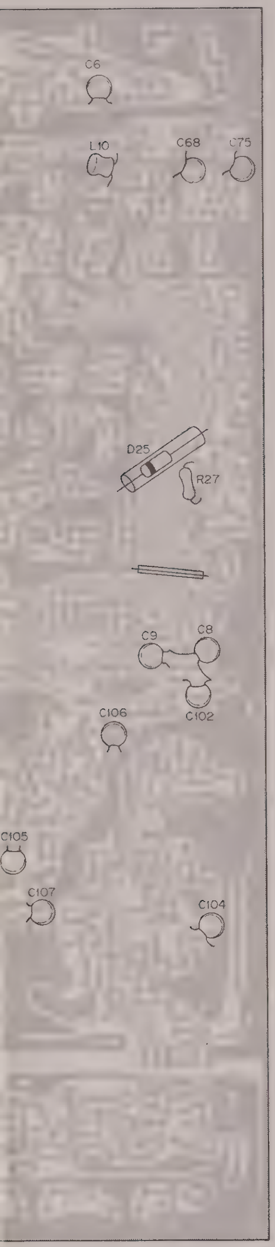


< Attachment method of R526,TH5 >



< Attachment method of R329,D108 >



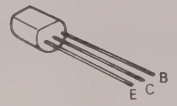


3(GR)

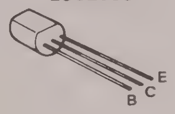
3–147,

M

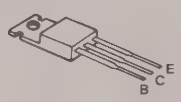
2SA984K
2SA1015
2SC1775
2SC1815
2SC1907
2SC1973



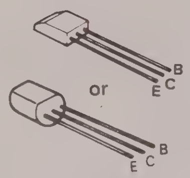
2SC2086



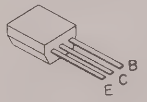
2SA473
2SD880



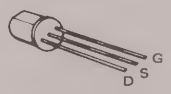
2SB460



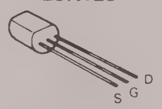
2SC2458



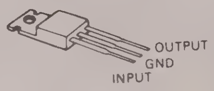
2SK19



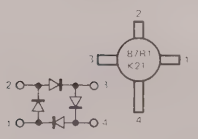
2SK30A
2SK125



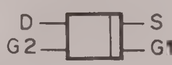
UA8718UC



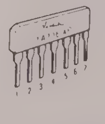
ND487R1-3R



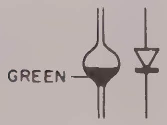
3SK73



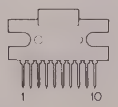
TA7302P



MV-13



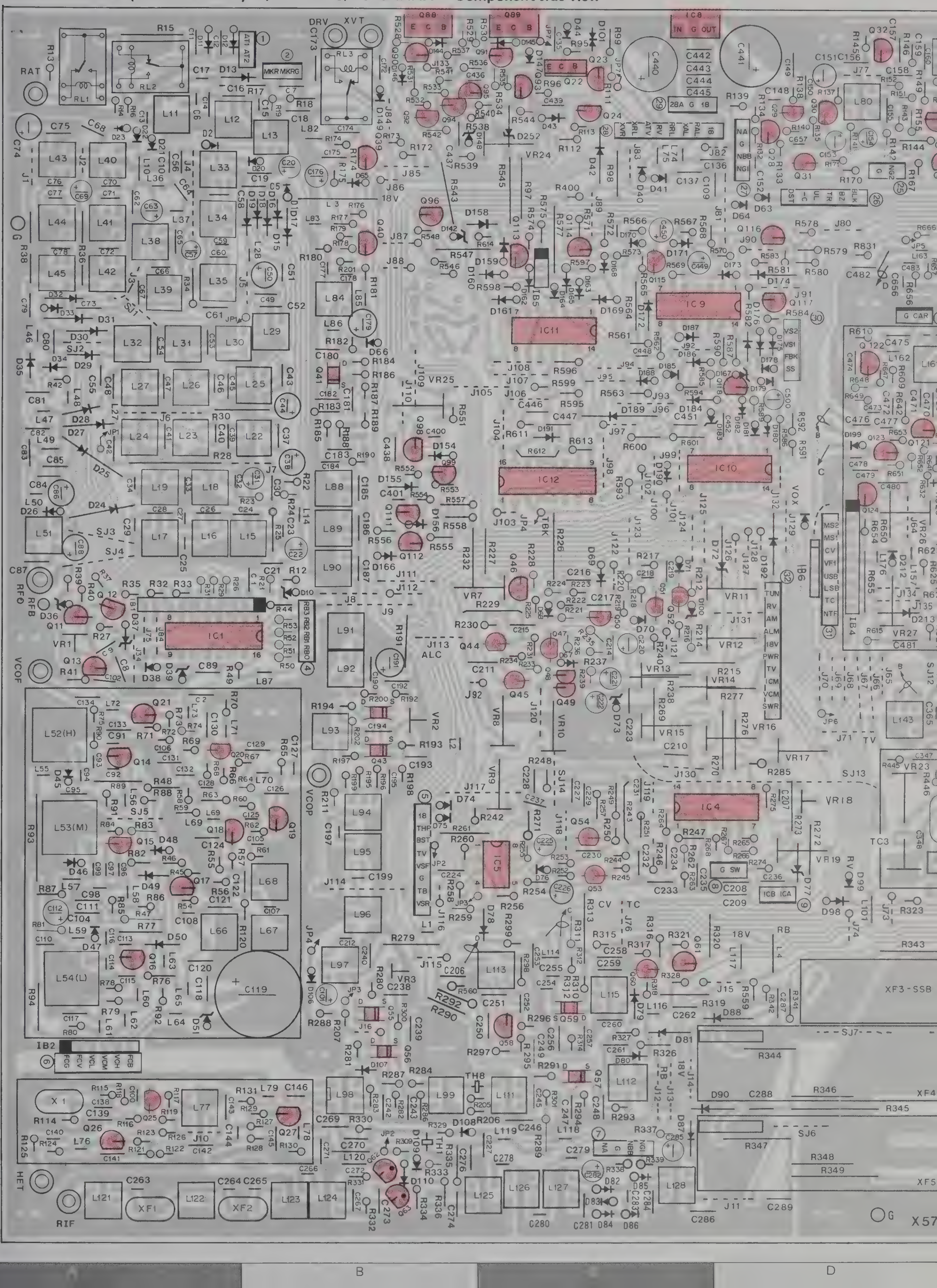
HA1368



TR,FET,IC and Terminals address

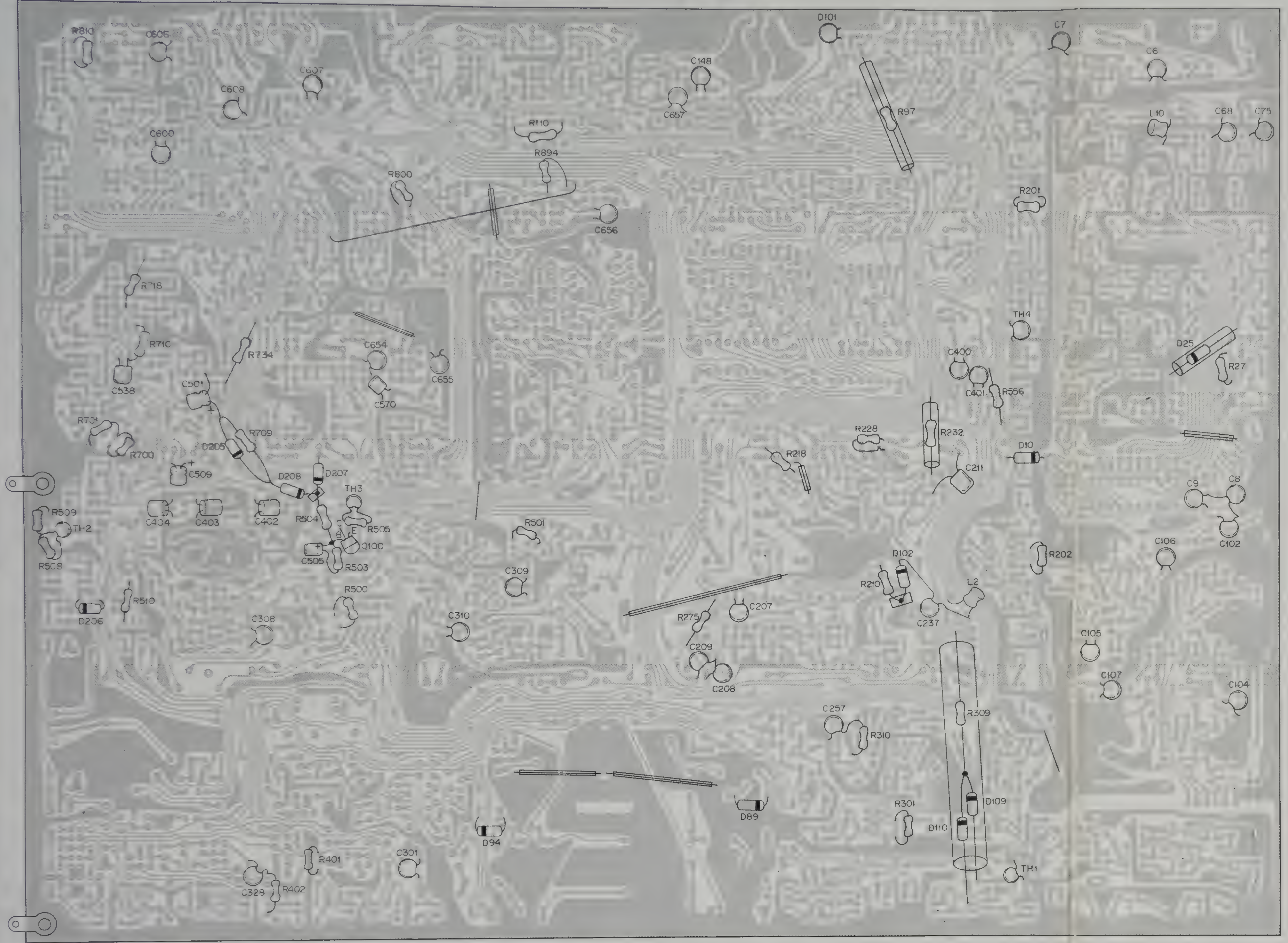
TR,FET	Address	TR,FET	Address	TR,FET	Address	Terminal	Address
Q1	Not used	Q71	G–6	Q141	F–3	①	A,B–1
Q2	Not used	Q72	G–6	Q142	F–3	②	B–1
Q3	Not used	Q73	G–6	Q143	E–4	③	B–2
Q4	Not used	Q74	G–6	Q144	E–3	④	B–3,4
Q5	Not used	Q75	E–5	Q145	E–3	⑤	B–4,5
Q6	Not used	Q76	E–4	Q146	E–3	⑥	A–6
Q7	Not used	Q77	E–4	Q147	F–3	⑦	C–6
Q8	Not used	Q78	E–4	Q148	E–2	⑧	C,D–5
Q9	Not used	Q79	E–4	Q149	E–2	⑨	D–5
Q10	Not used	Q80	F–4	Q150	F–2	⑩	E–6
Q11	A–3,4	Q81	F–4	Q151	F–2,3	⑪	F–6
Q12	A–4	Q82	F–5	Q152	F–2	⑫	F–4,5
Q13	A–4	Q83	F,G–5	Q153	F–2	⑬	E,F–4
Q14	A–4	Q84	G–5	Q154	F,G–2	⑭	E–3,4
Q15	A–5	Q85	G–4	Q155	F,G–2	⑮	E–3
Q16	A–5	Q86	F–4	Q156	G–2	⑯	F–2,3
Q17	A–5	Q87	G–4	Q157	G–1	⑰	F–2,3
Q18	A–5	Q88	B–1	Q158	G–1	⑱	F–3
Q19	B–4,5	Q89	C–1	Q159	G–1	⑲	G–3
Q20	A–4	Q90	B–1	Q160	G–1	⑳	G–2
Q21	A–4	Q91	C–1	Q161	F–1	㉑	G–2
Q22	C–1	Q92	B–1	Q162	E–1	㉒	F–1
Q23	C–1	Q93	C–1			㉓	F–1
Q24	C–1	Q94	B–1			㉔	D–2
Q25	A–6	Q95	B,C–1			㉕	D–1
Q26	A–6	Q96	B–1,2			㉖	D–1
Q27	B–6	Q97	Not used			㉗	D–1
Q28	D–1	Q98	B–3			㉘	C–1
Q29	D–1	Q99	B–3			㉙	C–1
Q30	D–1	Q100	B–3 (Foil side)			㉚	D–2
Q31	D–1	Q101	Not used			㉛	D–3
Q32	D–1	Q102	Not used			㉜	D–3,4
Q33	D,E–1	Q103	Not used				
Q34	E–1	Q104	Not used				
Q35	E–1	Q105	Not used				
Q36	E–1	Q106	Not used				
Q37	E–1	Q107	Not used				
Q38	D,E–1	Q108	Not used				
Q39	B–1	Q109	Not used				
Q40	B–2	Q110	Not used				
Q41	B–2	Q111	B–3	IC1	A–4		
Q42	B–4	Q112	B–3	IC2	E–1		
Q43	B–4	Q113	C–2	IC3	F–1		
Q44	B–4	Q114	C–2	IC4	C–4		
Q45	B–4	Q115	C–2	IC5	C–5		
Q46	C–3	Q116	D–2	IC6	G–6		
Q47	C–4	Q117	D–2	IC7	G–1,2		
Q48	C–4	Q118	D–2	IC8	C–1		
Q49	C–4	Q119	E–2	IC9	C–2		
Q50	C–4	Q120	E–2	IC10	C,D–3		
Q51	C–3	Q121	D–3	IC11	C–2		
Q52	C–3	Q122	D–2	IC12	C–3		
Q53	C–5	Q123	D–3				
Q54	C–4,5	Q124	D–3				
Q55	B–5	Q125	E–2				
Q56	B–6	Q126	E–2				
Q57	C–6	Q127	E–2				
Q58	C–5,6	Q128	G–4				
Q59	C–5	Q129	G–4				
Q60	C–5	Q130	G–3				
Q61	C–5	Q131	G–2				
Q62	B–6	Q132	G–2				
Q63	B–6	Q133	G–2				
Q64	E–5	Q134	G–2,3				
Q65	E–6	Q135	G–3				
Q66	E–6	Q136	F–3				
Q67	F–6	Q137	F,G–3				
Q68	F–6	Q138	G–3				
Q69	F–6	Q139	G–4				
Q70	F–6	Q140	F–3				

SIGNAL UNIT (X57-1000-11) A/2 From S/N310XXXX— Component side view


IC1
IC4
IC5
IC8
IN G OUT
IC9
IC10
IC11
IC12
RL1
RL2
RL3
DRV
XVT
RAT
RFO
RFB
VCOF
VCOP
HET
RIF
ALC
VOX
TBK
CV
TC
TC3
TV
18V
RB
XF1
XF2
XF3-SSB
X1
G SW
G CAR
ICB ICA
MKR MKRG
AT1 AT2
IB1
IB2
IB4
IB5
IB6
FCG FCV VCL VCM VCH FCB
TUN RV AM ALM 18V PWR TV CM VCM SWR
MS2 MS1 CV VF1 USB LSB TC NTF
VS2 VS1 FBK SS
18 THP BST TV VSF G TB VSR
NA G NBB NGI
XVR XRL ATV RV RRL XAL RAL 18
DST -C UL TR BZ BLK
28A G 18
L52(H)
L53(M)
L54(L)
C119
C440
C441
VR1
VR2
VR3
VR7
VR8
VR9
VR10
VR11
VR12
VR13
VR14
VR15
VR16
VR17
VR18
VR19
VR23
VR24
VR25
VR26
VR27
SJ1
SJ2
SJ3
SJ4
SJ5
SJ6
SJ7
SJ12
SJ13
SJ14
B
D
X57

TS-930S PC BOARD VIEWS

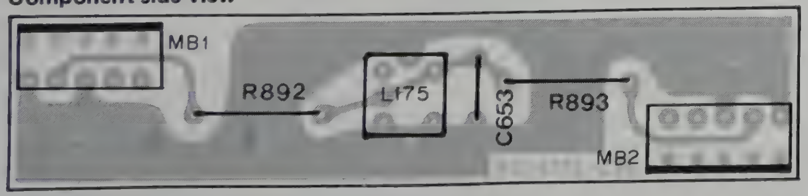
SIGNAL UNIT (X57-1000-11) A/2 From S/N208XXXX–309XXXX Foil side view


R813
C606
D101
C7
C148
C6
C607
C608
C657
R110
R97
L10
C68
C75
C600
R894
R800
R201
C656
R718
TH4
R710
R734
C654
C655
C400
D25
R27
C538
C501
C570
C401
R556
R731
R709
R228
R232
D10
R700
D205
D208
D207
R218
C211
C509
TH3
C9
C8
R509
TH-2
C404
C403
C402
R504
R505
R501
C106
C102
R508
C505
D100
R503
D102
R202
C309
L2
R500
R210
R510
D236
C308
C310
R275
C207
C237
C105
C209
C208
C107
C104
C257
R309
R310
D89
R301
D109
D110
D94
R401
C301
TH1
C329
R402

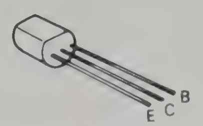
Q11,12,24,31,74,84,85,99,112,115,127,137,153,159 : 2SA1015(Y)
Q13,34–38,44–47,50,51,60,61,64,73,86,90–96,98,111,113,114,116–118,124,132–134,136,141–145,148–151,156,157,162 : 2SC1815(Y)
Q14–16,28,126,140,152,158 : 2SK19(GR) Q17–21,25,26,40 : 2SC1907 Q22 : 2SC2899 Q23 : 2SA984K(E)
Q27,29,30,32,33,58,71,72,75–77,79,119–123,125,131 : 2SB460(B) Q39 : 2SC1973(T) Q41–43,55–57,59,65–80,78,80,87,128–130 : 3SK73(GR)
Q48,49,100 : 2SC2458(Y) Q52 : 2SK30A(O) Q53,54,138,139,154,155 : 2SK30A(GR) Q62,63 : 2SK125 Q81 : 2SC2086
Q82,83,146,147,160 : 2SC1775(E) Q88,89 : 2SA473(Y) Q135 : 2SK30A(Y) Q161 : 2SD880(Y)
IC1 : SN74LS145N IC2,9 : TC4011BP IC3 : HA1368 IC4,7 : MB3614 IC5 : NJM2903D IC6 : TA7302P
IC8 : UA7818UC IC10 : TC4001BP IC11 : TC4073BP IC12 : TC4049BP
D10,71,125,205 : WZ-040 D11,12,38,40–43,57–66,68–70,74–76,78,91,92,98,99,108–110,112,113,116,117,119,121,123,124,135–138,143–147,149,154–156,158–166,168–182,184–192,205,207–209,212,213,215,219,226–231,234–237,242,243,246–250 : 1S1555 or 1N4448
D13,14,48–50,79,82,84–87,94,95,111,114,118,126–134,194–196,198,199,216,220,221,233 : 1S1587 D15–33 : 1S2588 D34,35 : BA379
D36,37 : XZ-033 D39 : XZ-051 D44 : 1JZ61 D45 : 1SV54GC D51,73,223,232,251 : WZ-150 D52–55,238–241 : 1N60
D56,67,120,222,225,245 : LT8001P D72,183,210 : WZ-120 D77 : XZ-200 D80,81,88–90,93,96,97 : 1S1007 D83,167 : WZ-090
D100,115,224 : WZ-071 D101 : ERZC07DK201 D102 : MV-13 D47,122,197 : 1SV54GE D140 : ND487R1-3R D148 : WZ-061 D217,244 : FC65M

SIGNAL UNIT (X57-1000-11) B/2

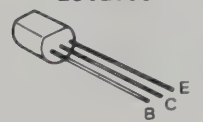
Component side view


MB1
R892
L175
C653
R893
MB2

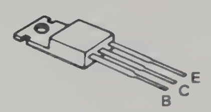
2SA984K
2SA1015
2SC1775
2SC1815
2SC1907
2SC1973



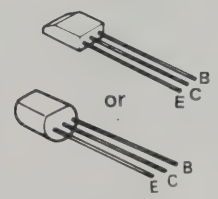
2SC2086



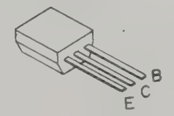
2SA473
2SD880



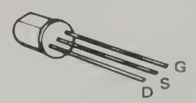
2SB460



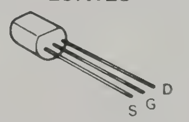
2SC2458



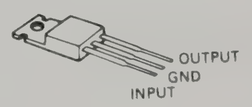
2SK19



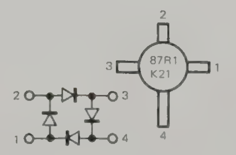
2SK30A
2SK125



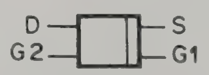
UA8718UC


OUTPUT
GND
INPUT

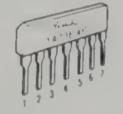
ND487R1-3R


2
3
1
4
87R1
K21
2
3
1
4

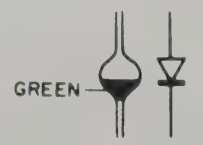
3SK73



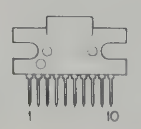
TA7302P



MV-13



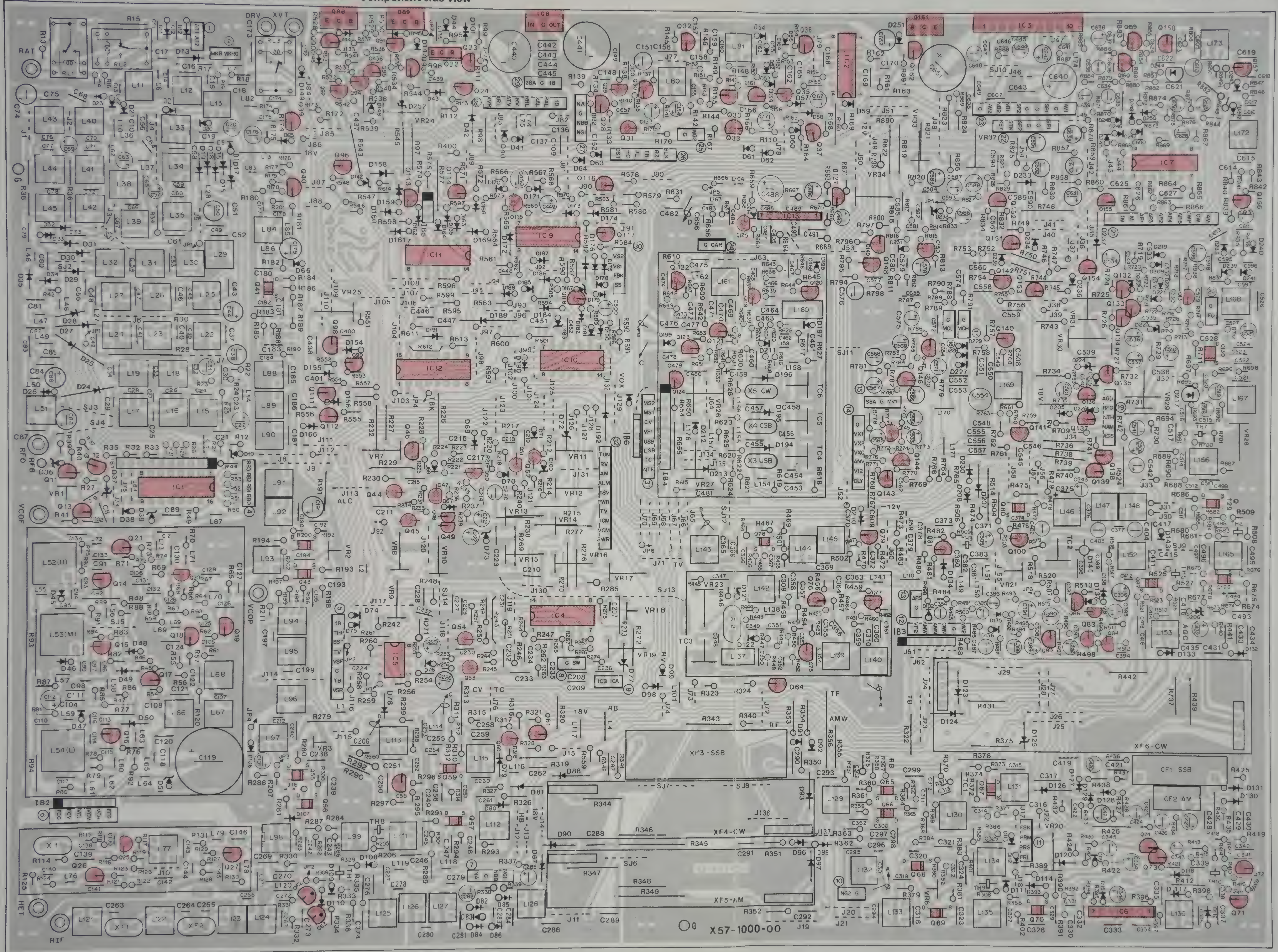
HA1368

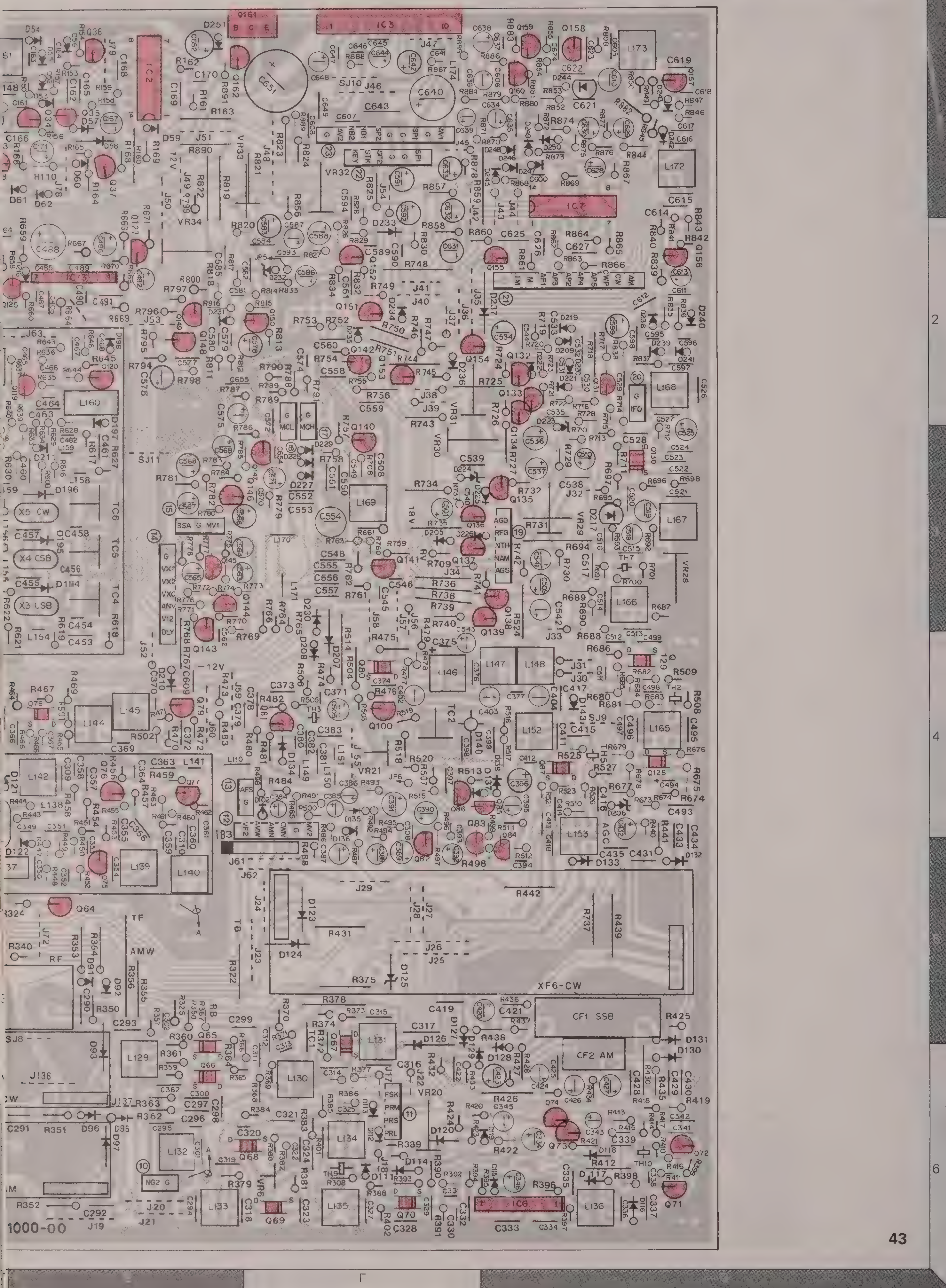


TR,FET,IC and Terminals address

TR,FET	Address	TR,FET	Address	TR,FET	Address	Terminal	Address
Q1	Not used	Q71	G−6	Q141	F−3	1	A,B−1
Q2	Not used	Q72	G−6	Q142	F−3	2	B−1
Q3	Not used	Q73	G−6	Q143	E−4	③	B−2
Q4	Not used	Q74	G−6	Q144	E−3	④	B−3,4
Q5	Not used	Q75	E−5	Q145	E−3	⑤	B−4,5
Q6	Not used	Q76	E−4	Q146	E−3	⑥	A−6
Q7	Not used	Q77	E−4	Q147	F−3	⑦	C−6
Q8	Not used	Q78	E−4	Q148	E−2	⑧	C,D−5
Q9	Not used	Q79	E−4	Q149	E−2	⑨	D−5
Q10	Not used	Q80	F−4	Q150	F−2	⑩	E−6
Q11	A−3,4	Q81	F−4	Q151	F−2,3	⑪	F−6
Q12	A−4	Q82	F−5	Q152	F−2	⑫	F−4,5
Q13	A−4	Q83	F,G−5	Q153	F−2	⑬	E,F−4
Q14	A−4	Q84	G−5	Q154	F,G−2	⑭	E−3,4
Q15	A−5	Q85	G−4	Q155	F,G−2	⑮	E−3
Q16	A−5	Q86	F−4	Q156	G−2	⑯	F−2,3
Q17	A−5	Q87	G−4	Q157	G−1	⑰	F−2,3
Q18	A−5	Q88	B−1	Q158	G−1	⑱	F−3
Q19	B−4,5	Q89	C−1	Q159	G−1	⑲	G−3
Q20	A−4	Q90	B−1	Q160	G−1	20	G−2
Q21	A−4	Q91	C−1	Q161	F−1	㉑	G−2
Q22	C−1	Q92	B−1	Q162	E−1	㉒	F−1
Q23	C−1	Q93	C−1			㉓	F−1
Q24	C−1	Q94	B−1			㉔	D−2
Q25	A−6	Q95	B,C−1			㉕	D−1
Q26	A−6	Q96	B−1,2			㉖	D−1
Q27	B−6	Q97	Not used			㉗	D−1
Q28	D−1	Q98	B−3			㉘	C−1
Q29	D−1	Q99	B−3			㉙	C−1
Q30	D−1	Q100	B−3 (Foil side)			㉚	D−2
Q31	D−1	Q101	Not used			㉛	D−3
Q32	D−1	Q102	Not used			㉜	D−3,4
Q33	D,E−1	Q103	Not used				
Q34	E−1	Q104	Not used				
Q35	E−1	Q105	Not used				
Q36	E−1	Q106	Not used				
Q37	E−1	Q107	Not used				
Q38	D,E−1	Q108	Not used				
Q39	B−1	Q109	Not used				
Q40	B−2	Q110	Not used				
Q41	B−2	Q111	B−3	IC1	A−4		
Q42	B−4	Q112	B−3	IC2	E−1		
Q43	B−4	Q113	C−2	IC3	F−1		
Q44	B−4	Q114	C−2	IC4	C−4		
Q45	B−4	Q115	C−2	IC5	C−5		
Q46	C−3	Q116	D−2	IC6	G−6		
Q47	C−4	Q117	D−2	IC7	G−1,2		
Q48	C−4	Q118	D−2	IC8	C−1		
Q49	C−4	Q119	E−2	IC9	C−2		
Q50	C−4	Q120	E−2	IC10	C,D−3		
Q51	C−3	Q121	D−3	IC11	C−2		
Q52	C−3	Q122	D−2	IC12	C−3		
Q53	C−5	Q123	D−3				
Q54	C−4,5	Q124	D−3				
Q55	B−5	Q125	E−2				
Q56	B−6	Q126	E−2				
Q57	C−6	Q127	E−2				
Q58	C−5,6	Q128	G−4				
Q59	C−5	Q129	G−4				
Q60	C−5	Q130	G−3				
Q61	C−5	Q131	G−2				
Q62	B−6	Q132	G−2				
Q63	B−6	Q133	G−2				
Q64	E−5	Q134	G−2,3				
Q65	E−6	Q135	G−3				
Q66	E−6	Q136	F−3				
Q67	F−6	Q137	F,G−3				
Q68	F−6	Q138	G−3				
Q69	F−6	Q139	G−4				
Q70	F−6	Q140	F−3				

SIGNAL UNIT (X57-1000-11) A/2 From S/N310XXXX— Component side view


X57-1000-00
XF1
XF2
XF3-SSB
XF4-CW
XF5-AM
XF6-CW
CF1 SSB
CF2 AM
IC1
IC2
IC3
IC4
IC5
IC6
IC7
IC8
IC9
IC10
IC11
IC12
IC13
IB2
IB3
IB6
RAT
RFO
VCOF
VCOP
RIF
HET
DRV
XVT
RL1
RL2
RL3
C119
C440
C441
C640
C651
R442
R431
R375
R439
R737

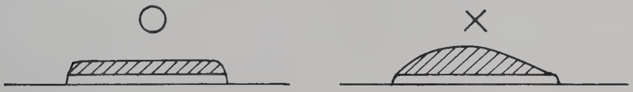

Q161
IC3
IC2
IC7
IC13
IC6
C651
C640
L173
L172
L168
L167
L166
L165
L160
L169
L170
L146
L147
L148
L152
L153
L144
L145
L142
L139
L140
L129
L130
L131
L132
L133
L134
L135
L136
XF6-CW
CF1 SSB
CF2 AM
X5 CW
X4 CSB
X3 USB
TC4
TC5
TC6
TC1
TC2
VR21
VR28
VR29
VR30
VR31
VR32
VR33
VR34
VR6
VR20
SJ8
SJ9
SJ10
SJ11
J136
J137
J61
J62
MCL
MCH
SSA G MV1
AGC
IFO
FSK
PRM
PRS
PRL
NG2 G
AFS
TF
TB
RF
AMW
12V
18V
-12V
1000-00
2
3
4
5
6
F

PARTS LIST

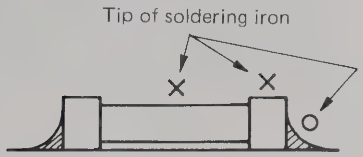
Note :

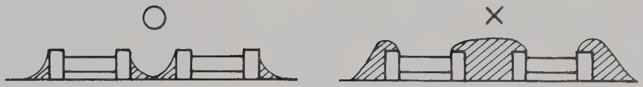
Soldering procedure for the chip capacitor

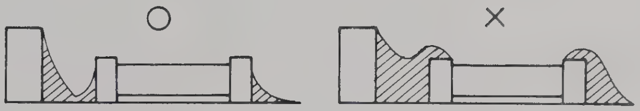
- Tools and materials
  Soldering iron
  1/8"–3/32" wide wedge tip
  Solder (Silver solder or low temperature solder)
  Soft jaw tweezers
  Hot plate or drier
- Soldering procedure
  1) Pre-heat the surface of chip capacitor up to around 150°C with the hot plate or drier.
  2) Apply solder to the tip of soldering iron.
  3) Hold and place the chip capacitor on the installation place with the tweezers.
  4) Solder one end of the chip capacitor using the tip of soldering iron.
  5) Solder the other end similarly.
- Caution
  1) Do not use too much solder. Use only enough solder to secure the component.



2) Length of soldering time :
In case of silver solder : Within 6 – 8 sec.
In case of low temperature solder : Within 3 – 4 sec.
3) Keep the temperature of tip of soldering iron below 280°C.







Note: If you damage the silver plating on the ends of the capacitors, they should be discarded as they are no longer capable of performing correctly.
Use care when soldering. Liberal use of additional flux will ease the task of soldering.

Abbreviation		Abbreviation	
Cap	Capacitor	ML	Mylar
C	Ceramic	S	Styrene
E	Electrolytic	T	Tantalum
MC	Mica		

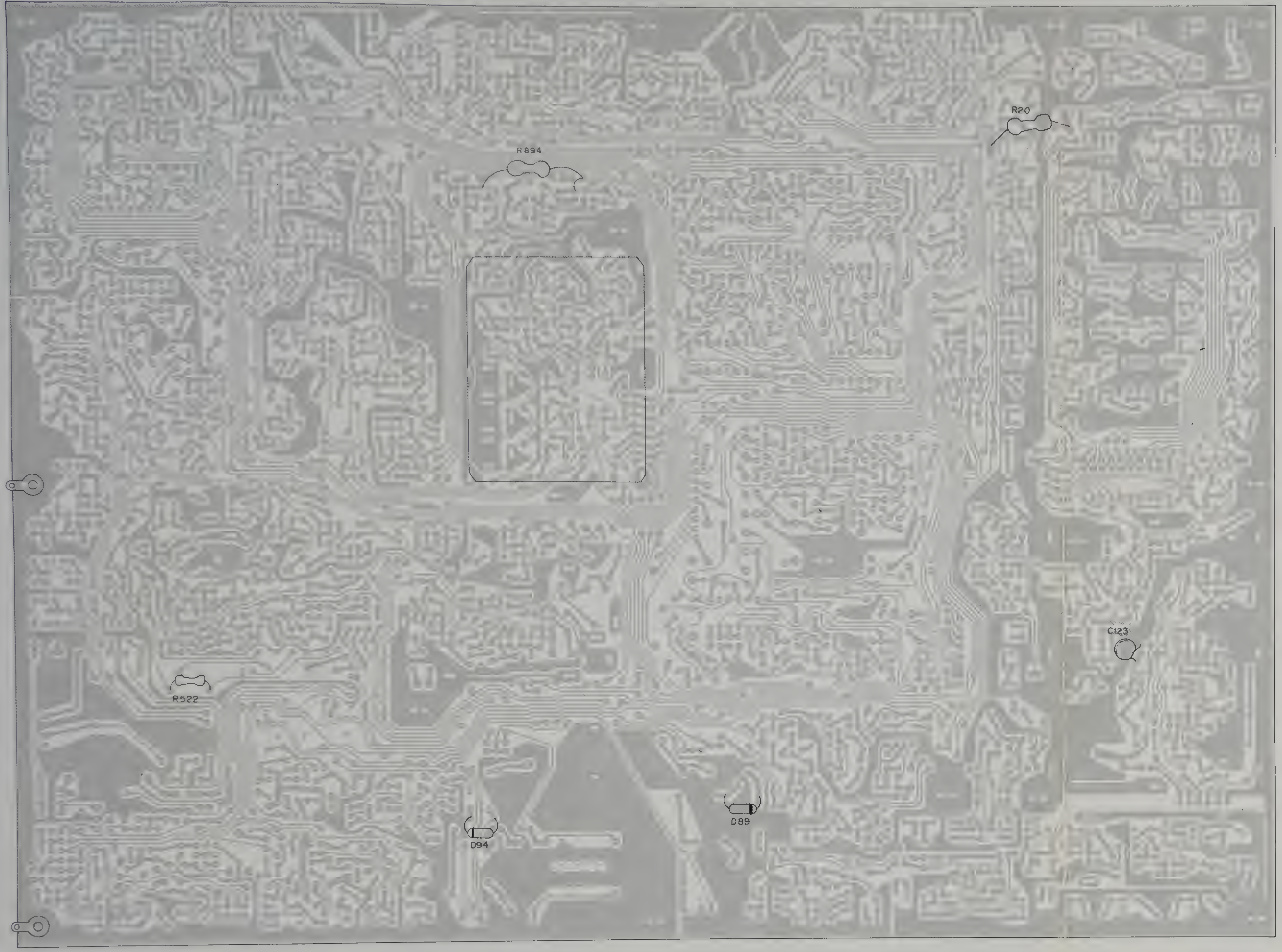
TS-930S SEMICONDUCTOR

N : New part not previously stocked for any model.

Name		Remarks	Parts No.
Diode	1JZ61	N	V11-3179-06
	1N60		V11-0051-05
	1N4448		V11-7766-06
	1S1007		V11-4160-66
	1S1555		V11-0076-05
	1S1587		V11-0370-05
	1S2588		
	1SS99	N	V11-1277-86
	BA379		V11-1263-06
	GM-3B		
	ND487R1-3R	N	V11-1266-16
	S15VB10	N	V11-1366-06
	V03(C)		V11-0290-05
	V06E		V11-0285-05
Varistor	MV-13		V21-0004-05
	STV-3H(O)	N	V21-0016-05
	SV-03Y		V21-0007-05
Vari-Cap	1SV54GC		V11-4173-46
	1SV54GE		V11-4173-56
	FC65M	N	V11-7776-86
Zener diode	BZ-192		V11-0311-05
	BZ-350		V11-4166-86
	CZ-078		
	RD33FBD-B1		
	WZ-040		V11-4161-56
	WZ-061		V11-0243-05
	WZ-071		V11-4160-86
	WZ-090		V11-0240-05
	WZ-120		V11-0249-05
	WZ-130		V11-0297-05
	WZ-150		V11-0307-05

TS-930S PC BOARD VIEWS

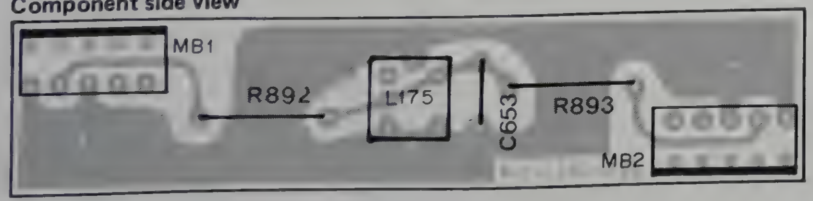
SIGNAL UNIT (X57-1000-11) A/2 From S/N310XXXX– Foil side view



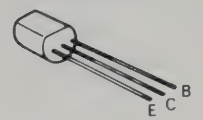
Q11,12,24,31,74,84,85,99,112,115,127,137,153,160 : 2SA1015(Y)
Q13,34–38,44–47,50,51,60,61,64,73,83,86,90–98,100,111,113,114,116–118,124,132–134,136,141–145,148–151,156,157,162 : 2SC1815(Y)
Q14–16,28,140,152,158 : 2SK192A*J(GR) Q17–21,25,26,40 : 2SC1907 Q22 : 2SD799 Q23 : 2SA984K(E)
Q27,29,30,32,33,58,71,72,75–77,79,119–123,125,131 : 2SC460(B) Q39 : 2SC1973(T) Q41–43,55–57,59,65–70,78,80,87,128–130 : 3SK73(GR)
Q48,49 : 2SC2458(Y) Q52 : 2SK30A(O) Q53,54,138,139,154,155 : 2SK30A(GR) Q62,63 : 2SK125 Q81 : 2SC2086
Q82 : 2SC2240(GR) Q88,89 : 2SA473(Y) Q135 : 2SK30A(Y) Q146,147,159 : 2SC1775(E) Q161 : 2SD880(Y)
IC1 : SN74LS145N IC2,9 : TC4011BP IC3 : HA1368 IC4,7 : MB3614 IC5 : NJM2903D IC6 : TA7302P
IC8 : UA7818UC IC10 : TC4001BP IC11 : TC4073BP IC12 : TC4049BP IC13 : μPC1037H
D1,2,15–33 : 1S2588 D10,71,125,206 : WZ-040 D11,12,38,40–43,57–66,68–70,74–76,78,91,92,98,99,106,108–110,112,113,116,117,119,
121,123,124,135–138,143–147,149–166,168–182,184–192,205,207–209,212,213,219,226–231,234–237,242,243,246–250 : 1S1555 or 1N4448
D13,48–50,79,82,84–87,89,94–96,111,114,118,126–134,194–196,198–200,216,221,233 : 1S1587 D34,35 : BA379 D36,37 : XZ-033
D39 : XZ-051 D44 : 1JZ61(W) D45,46 : 1SV54GC D47,122,197 : 1SV54GE D51,73,223,232,251 : WZ-150 D52–55,238–241 : 1N60
D56,67,120,222,225,245 : LT8001P D72,183,210 : WZ-120 D77 : XZ-200 D80,81,88,90,93,97 : 1S1007 D83,167 : WZ-090 D100,115,224 : WZ-071
D101 : ERZC07DK201 D102,148 : WZ-061 D107 : MV-203 D140 : ND487R1-3R D142,252 : WZ-070 D211 : MV-12 D217,244 : FC65M

SIGNAL UNIT (X57-1000-11) B/2

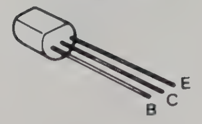
Component side view



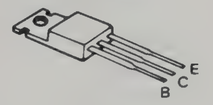
2SA984K
2SA1015
2SC1775
2SC1815
2SC1907
2SC1973
2SC2240



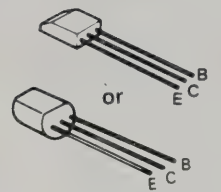
2SC2086



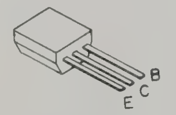
2SA473
2SD880



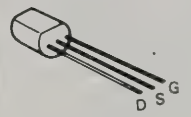
2SB460



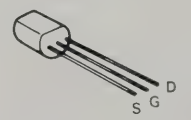
2SC2458



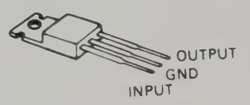
2SK192A*J



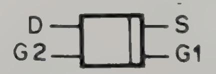
2SK30A
2SK125



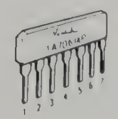
UA8718UC



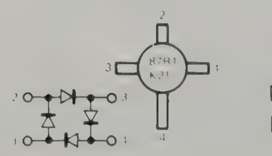
3SK73



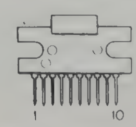
TA7302P
μPC1037H



ND487R1-3R



HA1368



TR, FET, IC and Terminals address from S/N 310XXXX–

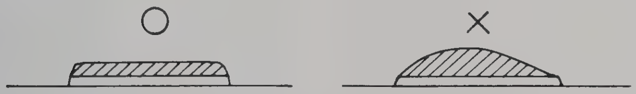
TR,FET	Address	TR,FET	Address	TR,FET	Address	Terminal	Address
Q1	Not used	Q71	G–6	Q141	F–3	①	A,B–1
Q2	Not used	Q72	G–6	Q142	F–3	②	B–1
Q3	Not used	Q73	G–6	Q143	E–4	③	B–2
Q4	Not used	Q74	G–6	Q144	E–3	④	B–3,4
Q5	Not used	Q75	E–5	Q145	E–3	⑤	B–4,5
Q6	Not used	Q76	E–4	Q146	E–3	⑥	A–6
Q7	Not used	Q77	E–4	Q147	F–3	⑦	C–6
Q8	Not used	Q78	E–4	Q148	E–2	⑧	C,D–5
Q9	Not used	Q79	E–4	Q149	E–2	⑨	D–5
Q10	Not used	Q80	F–4	Q150	F–2	10	E–6
Q11	A–3,4	Q81	F–4	Q151	F–2,3	11	F–6
Q12	A–4	Q82	F–5	Q152	F–2	12	F–4,5
Q13	A–4	Q83	F,G–5	Q153	F–2	13	E,F–4
Q14	A–4	Q84	G–5	Q154	F,G–2	14	E–3,4
Q15	A–5	Q85	G–4	Q155	F,G–2	15	E–3
Q16	A–5	Q86	F–4	Q156	G–2	16	F–2,3
Q17	A–5	Q87	G–4	Q157	G–1	17	F–2,3
Q18	A–5	Q88	B–1	Q158	G–1	18	F–3
Q19	B–4,5	Q89	C–1	Q159	G–1	19	G–3
Q20	A–4	Q90	B–1	Q160	G–1	20	G–2
Q21	A–4	Q91	C–1	Q161	F–1	21	G–2
Q22	C–1	Q92	B–1	Q162	E–1	22	F–1
Q23	C–1	Q93	C–1			23	F–1
Q24	C–1	Q94	B–1			24	D–2
Q25	A–6	Q95	B,C–1			25	D–1
Q26	A–6	Q96	B–1,2			26	D–1
Q27	B–6	Q97	Not used			27	D–1
Q28	D–1	Q98	B–3			28	C–1
Q29	D–1	Q99	B–3			29	C–1
Q30	D–1	Q100	F–4			30	D–2
Q31	D–1	Q101	Not used			31	D–3
Q32	D–1	Q102	Not used			32	D–3,4
Q33	D,E–1	Q103	Not used				
Q34	E–1	Q104	Not used				
Q35	E–1	Q105	Not used				
Q36	E–1	Q106	Not used				
Q37	E–1	Q107	Not used				
Q38	D,E–1	Q108	Not used				
Q39	B–1	Q109	Not used				
Q40	B–2	Q110	Not used				
Q41	B–2	Q111	B–3	IC1	A–4		
Q42	B–4	Q112	B–3	IC2	E–1		
Q43	B–4	Q113	C–2	IC3	F–1		
Q44	B–4	Q114	C–2	IC4	C–4		
Q45	B–4	Q115	C–2	IC5	C–5		
Q46	C–3	Q116	D–2	IC6	G–6		
Q47	C–4	Q117	D–2	IC7	G–1,2		
Q48	C–4	Q118	D–2	IC8	C–1		
Q49	C–4	Q119	E–2	IC9	C–2		
Q50	C–4	Q120	E–2	IC10	C,D–3		
Q51	C–3	Q121	D–3	IC11	C–2		
Q52	C–3	Q122	D–2	IC12	C–3		
Q53	C–5	Q123	D–3	IC13	E-2		
Q54	C–4,5	Q124	D–3				
Q55	B–5	Q125	E–2				
Q56	B–6	Q126	Not used				
Q57	C–6	Q127	E–2				
Q58	C–5,6	Q128	G–4				
Q59	C–5	Q129	G–4				
Q60	C–5	Q130	G–3				
Q61	C–5	Q131	G–2				
Q62	B–6	Q132	G–2				
Q63	B–6	Q133	G–2				
Q64	E–5	Q134	G–2,3				
Q65	E–6	Q135	G–3				
Q66	E–6	Q136	F–3				
Q67	F–6	Q137	F,G–3				
Q68	F–6	Q138	G–3				
Q69	F–6	Q139	G–4				
Q70	F–6	Q140	F–3				

PARTS LIST

Note :

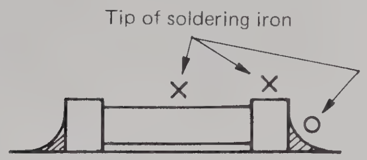
Soldering procedure for the chip capacitor

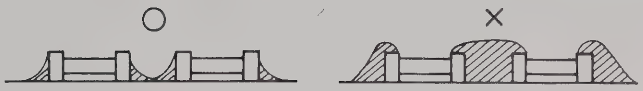
- Tools and materials
  Soldering iron
  1/8″–3/32″ wide wedge tip
  Solder (Silver solder or low temperature solder)
  Soft jaw tweezers
  Hot plate or drier
- Soldering procedure
  1) Pre-heat the surface of chip capacitor up to around 150°C with the hot plate or drier.
  2) Apply solder to the tip of soldering iron.
  3) Hold and place the chip capacitor on the installation place with the tweezers.
  4) Solder one end of the chip capacitor using the tip of soldering iron.
  5) Solder the other end similarly.
- Caution
  1) Do not use too much solder. Use only enough solder to secure the component.

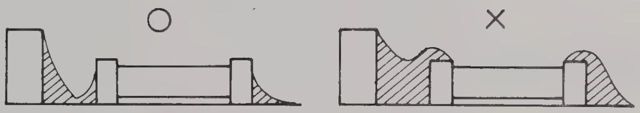


2) Length of soldering time :
In case of silver solder : Within 6 – 8 sec.
In case of low temperature solder : Within 3 – 4 sec.

3) Keep the temperature of tip of soldering iron below 280°C.







Note: If you damage the silver plating on the ends of the capacitors, they should be discarded as they are no longer capable of performing correctly.

Use care when soldering. Liberal use of additional flux will ease the task of soldering.

Abbreviation		Abbreviation	
Cap	Capacitor	ML	Mylar
C	Ceramic	S	Styrene
E	Electrolytic	T	Tantalum
MC	Mica		

TS-930S SEMICONDUCTOR

N : New part not previously stocked for any model.

	Name	Remarks	Parts No.
Diode	1JZ61	N	V11-3179-06
	1N60		V11-0051-05
	1N4448		V11-7766-06
	1S1007		V11-4160-66
	1S1555		V11-0076-05
	1S1587		V11-0370-05
	1S2588		
	1SS99	N	V11-1277-86
	BA379		V11-1263-06
	GM-3B		
	ND487R1-3R	N	V11-1266-16
	S15VB10	N	V11-1366-06
	V03(C)		V11-0290-05
	V06E		V11-0285-05
Varistor	MV-13		V21-0004-05
	STV-3H(O)	N	V21-0016-05
	SV-03Y		V21-0007-05
Vari-Cap	1SV54GC		V11-4173-46
	1SV54GE		V11-4173-56
	FC65M	N	V11-7776-86
Zener diode	BZ-192		V11-0311-05
	BZ-350		V11-4166-86
	CZ-078		
	RD33FBD-B1		
	WZ-040		V11-4161-56
	WZ-061		V11-0243-05
	WZ-071		V11-4160-86
	WZ-090		V11-0240-05
	WZ-120		V11-0249-05
	WZ-130		V11-0297-05
	WZ-150		V11-0307-05

PARTS LIST

Name		Remarks	Parts No.
	WZ-182		V11-4100-10
	WZ-192		V11-0308-05
	XZ-033		V11-4176-96
	XZ-051		V11-4103-60
	XZ-055		V11-4105-51
	XZ-066		V11-4106-70
	XZ-076		V11-4126-36
	XZ-090		V11-4167-06
	XZ-122		
	XZ-200		V11-4101-70
LED	BG5532K (Green)	N	V11-7261-16
	LT8001P	N	V11-4360-76
	PR5532K (Blue)		V11-7272-36
Surge absorber	ERZC07DK201	N	V11-1163-26
	ERZD03DK331		V11-1163-16
Thermistor	25D29		V11-3360-16
	SDT500		
	SDT1000		
	5T-35		V11-2262-06
	5T-41		V11-2263-06
Photo interruptor	ON1110	N	V11-1173-86
	ON1105		V11-1173-76
Display tube	11-BT-03Z	N	V40-7760-66
TR	2SA473(Y)		V01-0473-06
	2SA496(Y)		V01-0113-05
	2SA733(P)		V01-0733-16
	2SA950(Y)	N	V01-0950-16
	2SA984K(E)	N	V01-0984-10
	2SA1015(Y)		V01-1015-06
	2SA1021(O)	N	V01-1021-16
	2SA1049(GR)	N	V01-1049-16
	2SB861(C)		
	2SC460(B)		V03-0079-05
	2SC496(Y)		V03-0336-05
	2SC1775(E)		V03-1775-06
	2SC1815(Y)		V03-1815-06
	2SC1907		V03-1907-06
	2SC1923(O)		V03-1923-06
	2SC1959(Y)		V03-1959-06
	2SC1973(T)		V03-1973-16
	2SC2053		V03-2053-06
	2SC2075		V03-2075-06
	2SC2086		V03-2086-06
	2SC2120(Y)		V03-2120-06
	2SC2274K(E)	N	V03-2274-26
	2SC2458(Y)		V03-2458-06
	2SC2899	N	V03-2899-06
	2SD880(Y)		V04-0880-16
	2N5885		V08-1012-06
	MRF422	N	V08-1008-46
	MRF485	N	V08-1008-56
FET	2SK19(GR)		V09-0012-05
	2SK30A(GR)		V09-0060-05
	2SK30A(O)		V09-0056-05
	2SK30A(Y)		V09-0058-05
	2SK125		V09-1004-26
	2SK125P	N	V09-1004-36
	2SK192A*J(GR)		
	3SK73(GR)		V09-1002-46
IC	HA1368	N	V30-1129-16
	HD10116	N	V30-1243-06
	HD10125	N	V30-1243-16
	HD10131	N	V30-1243-26
	HD74LS00P		V30-1046-06
	HD74LS01P		V30-1009-36
	HD74LS02P		V30-1007-36
	HD74LS73P		V30-1076-16
	HD74LS75P		V30-1008-96
	HD74LS90P		V30-1083-06
	HD74LS151P		V30-1008-26
	LM358P		V30-1024-56
	MB74LS42		V30-1241-46
	MB3614	N	V30-1242-16
	MC1723CL		V30-0199-05
	MC14077B	N	V30-1211-36
	MC145155P*J	N	
	MC145156P	N	V30-1203-36
	MC14569BCP		V30-1100-06
	MD74LS90P		
	NE555P	N	V30-0686-10
	NJM2901	N	V30-1020-56
	NJM2903D	N	V30-1020-96
	NJM2904D	N	V30-1021-06
	SN74LS00N		V30-1005-66
	SN74LS01N		V30-1041-16
	SN74LS02N		V30-1041-06
	SN74LS73N		V30-1117-06
	SN74LS75N		V30-1005-16
	SN74LS90N		V30-1005-26
	SN74LS145N	N	V30-1152-26
	SN74LS151N		V30-1240-16
	SN16913P		V30-1048-06
	TA78L005AP	N	V30 1189-36
	TA7302P		V30-1134-06
	TC4001BP		V30-1066-06
	TC4011BP		V30-1030-66
	TC4049BP		V30-1009-26
	TC4073BP	N	V30-1167-16
	TC5065BP		V30-1056-16
	TC5081P		V30-1132-06
	TC9122P		V30-1036-16
	UA7818UC	N	V30-1022-46
	μPB551C	N	V30-0170-16
	μPC14305		V30-1029-26
	μPC14305H		V30-1029-36
	μPC14312		V30-1029-56
	μPD5101LC		V30-1177-36
	μPD8049C-211	N	V30-1176-46
	μPD8243C	N	V30-1177-16

PARTS LIST

○ : From S/N208XXXX–309XXXX
● : From S/N310XXXX–

TS-930S GENERAL

Parts No.	Re marks	Description	Ref. No.
A01-0922-21	N	Case (upper)	
A01-0927-21	N	Case (lower) ○	
A01-0927-31	N	Case (lower) ●	
A20-2440-12	N	Panel	
A23-1466-22	N	Rear panel	
B03-0525-04	N	Switch mask x 2 RIT	
B03-0526-04	N	Switch mask POWER	
B05-0722-04	N	SP grill cloth	
B06-0504-04	N	Front glass grill cloth	
B07-0638-04	N	Band escutcheon	
B09-0011-04		Rubber cap	
B10-0650-13	N	Front glass (large)	
B10-0651-04	N	Front glass (small)	
B30-0826-05	N	Pilot lamp x 2 28V	PL1,2
B31-0635-05	N	Meter	
B40-2605-04	N	Name plate TS-930S **T**	
B40-2606-04	N	Name plate TS-930S **K,M,W,X**	
B41-0629-04	N	Caution plate	
B42-1727-04	N	Adj. seal	
B42-1728-04	N	Adj. seal VOX CONTROL	
B42-1729-04	N	Name plate	
B42-1777-04		Adj. seal ○	
B42-1794-04	N	Adj. seal ●	
B43-0669-04		Name plate TRIO **T**	
B43-0670-04		Name plate KENWOOD **K,M,W,X**	
B43-0676-04	N	Name plate	
B46-0407-00		Warranty card **K**	
B50-3959-20	N	Instruction manual **K,M,W,X**	
B50-3961-10	N	Instruction manual **T**	
B58-0644-11	N	Instruction sheet	
CE04W2C3R3		E 3.3 160V	C14
CK45E2H103P		C 0.01 500V x 4	C4–7
CK45F1H103Z		C 0.01 x 4	C10–13
C90-0857-05	N	E 22000 50V x 2	C8,9
C91-0079-05		C 0.01 2kV	C1
C91-0496-05		C 470pF AC 150V x 2	C2,3
E06-0751-05		7P DIN socket REMOTE	
E06-0851-05		8P DIN socket X. VERTER	
E07-0751-05		7P DIN plug Accessory	
E07-0852-05		8P metal socket Accessory **K,T,W**	
E11-0404-05		3P phone jack x 2 KEY,PHONE	
E11-0410-05		Phone jack EXT. SP	
E12-0001-15		Phone plug EXT. SP Accessory	
E13-0101-05		1P pin jack RX ANT	
E13-0461-05		4P pin jack	
E18-0351-05		3P inlet AC Power	
E20-0315-05		Terminal plate	
E23-0015-04		Lug plate x 2 GND	
E29-0407-05		Bridge connector	
E30-1643-15		AC cord ass'y **K,M**	
E30-1644-15		AC cord ass'y **T**	
E30-1645-05		AC cord ass'y **W**	
E30-1647-05		AC cord ass'y **X**	
E31-2102-05		Connector with lead	
F01-0776-23	N	Heat sink Power supply	
F05-4022-05		Fuse 4A x 2 **M,T,W,X**	F1
F05-6021-05		Fuse 6A **M**	F1
F05-6021-05		Fuse 6A x 2 **K**	F1
F07-0841-14	N	Slide cover	
F07-0842-13	N	Heat sink cover	
F09-0405-24		Fan	
F20-0525-05		Insulating sheet ●	
F20-0527-05	N	Insulating sheet x 2 TR	
F29-0014-05		Shoulder washer ●	
F29-0401-04		Capacitor mounting hardware x 2	
F29-0406-03		Fan motor mounting hardware	
F29-0421-04	N	Protective sheet x 5	
G01-0817-04	N	Coil spring x 4	
G09-0405-05		Knob fixed spring	
G09-0410-05		Knob fixed spring x 3	
G13-0662-04	N	Cushion Speaker	
G53-0510-04		Packing x 2 Case	
G53-0511-04		Packing x 2	
H01-4409-14	N	Packing carton (inside) **K,M,W,X**	
H01-4410-14	N	Packing carton (inside) **T**	
H10-1276-04		Cushion **M,X**	
H10-2558-02	N	Packing fixture (F)	
H10-2559-02	N	Packing fixture (R)	
H12-0491-04	N	Cushion **K,T,W,X**	
H20-1403-03		Protective cover	
H25-0105-04		Protective bag 150 x 350	
H25-0120-04		Protective bag	
J02-0049-14		Foot (large) x 2 Rear	
J02-0423-04		Foot x 2 Front	
J02-0424-04		Foot x 2	
J02-0426-05	N	Foot (small) x 4	
J13-0033-15		Fuse holder	
J19-1354-05		Battery case	
J61-0019-05		Vinyle tie x 20	
J61-0401-05		Nylon band x 30	
K01-0409-05	N	Handle	
K21-0763-04	N	Knob RIT	
K21-0764-04	N	Knob x 3 PITCH,AF,HIGH	
K21-0765-04	N	Knob x 2 CAR,OUT	
K21-0766-05	N	Main knob	
K23-0721-04		Knob NB LEVEL	
K23-0740-04		Knob x 3 AF TUNE,RF,LOW	
K23-0745-04		Knob x 5 MIC,VOX GAIN,ANTI, DELAY,IN	
K23-0753-04	N	Pointer knob x 5 METER,RF ATT, AGC,FUNCTION,MEMORY CH	
K27-0431-04	N	Push knob 1MHz STEP UP	
K27-0432-04	N	Push knob 1MHz STEP DOWN	
K27-0433-04	N	Push knob x 12 RIT,CLEAR,MR, TF-SET,NOTCH,AF TUNE,MIN, D. LOCK,A=B,VFO/MEMO,NB1,NB2	
K27-0434-04	N	Push knob x 4 VOX/MAN,MONI, FULL/SEMI, DIM/NOR	
K29-0715-04		Pointer knob MODE	
K29-0738-04		Knob (6) x 2 NOTCH,CW VBT	
K29-0757-04		Push knob POWER	
K29-0760-04	N	Push knob BAND	
K29-0761-04	N	Knob ring	
L01-8156-25	N	Power transformer	T1
N09-0256-05		Gnd. screw x 4	
N09-0642-04	N	Hex. head screw x 4	
N10-2030-46		Nut x 7	

PARTS LIST

Parts No.	Re marks	Description	Ref. No.
N14-0115-05		Flange nut	
N14-0509-05		Wing nut	
N14-0512-05		Speed nut x 5	
N15-1030-41		Flat washer x 6	
N15-1040-41		Flat washer x 5	
N30-2004-41		Round screw x 6	
N30-2604-41		Round screw x 5	
N30-2605-46		Round screw x 8	
N30-2606-45		Round screw x 4	
N30-2606-46		Round screw x 3	
N30-3004-46		Round screw x 15	
N30-3006-46		Round screw x 11	
N30-3014-41		Round screw x 4	
N30-4016-46		Round screw	
N32-2006-41		Flat screw x 2	
N32-3006-41		Flat screw x 15	
N33-3006-45		Round flat screw x 2	
N35-3006-41		Bind screw x 7	
N35-3006-45		Bind screw x 5	
N35-3008-45		Bind screw x 6	
N35-4006-46		Bind screw x 2 Handle	
N35-4008-41		Bind screw x 16	
N87-2608-41		Self tapping screw x 6	
N87-2608-46		Self tapping screw x 6	
N87-3006-41		Self tapping screw x 81	
N87-3008-41		Self tapping screw x 4	
N87-3012-46		Self tapping screw x 9	
N87-3014-46		Self tapping screw x 6	
N87-4010-41		Self tapping screw x 4	
N88-2606-46		Flat tapping screw x 2	
N89-3006-45		Bind tapping screw x 15	
RC05GF2H101J		Solid 100Ω 1/2W x 2	R11,12
RC05GF2H221J		Solid 220Ω 1/2W	R13
RD05GF2H472J		Solid 4.7kΩ 1/2W	R15
RS14AB3D181J		MF 180Ω 2W x 3	R5–7
RS14AB3D220J		MF 22Ω 2W ●	R7
RS14AB3D270J		MF 27Ω 2W x 4	R1–4
RS14AB3D330J		MF 33Ω 2W	R10
RS14AB3D820J		MF 82Ω 2W x 2	R8,9
RS14AB3D822J		MF 8.2kΩ 2W	R16
R92-0619-05		Cement 0.05Ω 5W	R14
S29-2406-05	N	Voltage selector	
S31-1407-05	N	Slide switch	
S40-2437-05	N	Push switch	S38
S50-1406-05		Tact switch x 2 **M,X**	
S51-1416-05		Relay	RL1
S90-0401-05	N	Remote switch shaft MODE	
T07-0221-05	N	Speaker	
T42-0302-05		Fan motor	
T91-0316-15		Microphone **M,X**	
X41-1410-00	N	Switch unit	
X43-1430-00	N	Power supply unit	
X44-1490-00	N	RF unit	
X50-1880-00	N	PLL unit	
X51-1280-00	N	LPF unit	
X54-1670-00	N	Digital unit	
X54-1680-00	N	Main encoder unit	
X54-1690-00	N	RIT encoder unit	
X56-1430-00	N	100W final unit	
X57-1000-11	N	Signal unit	
X57-1010-00		AT unit	

Parts No.	Re marks	Description	Ref. No.	Q'ty
SWITCH UNIT (X41-1410-00)				
CK45B1H012K		C 0.001	C10	1
CK45E2H103P		C 0.01	C1	1
CK45F1H103Z		C 0.01	C2,5,6	3
CK45F1H103Z		C 0.01 ○	C8	1
CK45F1H473Z		C 0.047	C3,4	2
CQ92M1H153K		ML 0.015	C9	1
C91-0456-05		C 0.047	C7	1
C91-0456-05		C 0.047 ●	C8	1
E04-0152-05		UHF type receptacle ANT		1
E04-0157-05		Mini pin jack A		1
E06-0853-05		8P metal socket MIC		1
E23-0047-04		Square terminal		5
E40-0273-05		Mini connector 2P		3
E40-0274-05		Mini connector 2PL ●		2
E40-0277-05		Mini connector 2PL ○		2
E40-0473-05		Mini connector 4P		1
E40-0573-05		Mini connector 5P		2
E40-0574-05		Mini connector 5PL ●		1
E40-0577-05		Mini connector 5PL ○		1
E40-0673-05		Mini connector 6P		1
E40-0773-05		Mini connector 7P		1
E40-0874-05		Mini connector 8PL ●		1
E40-0877-05		Mini connector 8PL ○		1
G53-0511-04		Packing		2
J61-0019-05		Vinyle tie		1
L33-0658-05	N	Choke coil	L1,2	2
L40-1511-03		Ferri-inductor ●	L3	1
N14-0115-05		Flange nut		1
N15-1040-46		Flat washer		1
N30-4025-46		Round screw GND		1
R01-0406-05	N	Pot. 300Ω(B) NB LEVEL	VR8	1
R01-3422-05	N	Pot. 10kΩ(B) VOX GAIN	VR9	1
R01-3423-05	N	Pot. 10kΩ(F) NOTCH	VR6	1
R01-3424-05	N	Pot. 10kΩ(B) CW VBT	VR5	1
R01-6403-05	N	Pot. 470kΩ(B) ANTI, DELAY	VR10,11	2
R19-3413-05	N	Pot. 10kΩ(A), 10kΩ(B) AF/RF	VR7	1
R19-3414-05	N	Pot. 10kΩ(B)x2 SSB SLOPE TUNE	VR3	1
R19-9407-05	N	Pot. 10kΩ(A), 50kΩ(C) PRO., MIC/CAR	VR1,2	2
R24-9402-05	N	Pot. 10kΩ(F), 100kΩ(C)x2 PITCH/AF TUNE	VR4	1
RC05GF2H102J		Solid 1kΩ 1/2W	R26	1
RC05GF2H680J		Solid 68Ω 1/2W	R6	1
RS14AB3D470J		MF 47Ω 2W	R2,3	2
R92-0150-05		Short jumper		4
S01-1429-05	N	Rotary switch M.CH	S24	1
S01-1430-05	N	Rotary switch METER	S39	1
S01-1431-05	N	Rotary switch AGC	S40	1

PARTS LIST

Parts No.	Re marks	Description	Ref. No.	Q'ty
S01-1432-05	N	Rotary switch FUNCTION, RF ATT	S23,25	2
S36-1408-05	N	Paddle switch CAL	S38	1
S36-2408-05	N	Paddle switch STBY, AT,PRO,TONE	S6–9	4
S40-2422-05		Push switch NOTCH,D.LOCK	S14,16	2
S40-2431-05	N	Push switch RIT	S12	1
S40-2432-05	N	Push switch T.F SET,RIT.CL	S11,13	2
S40-2433-05	N	Push switch VOX/MAN DIM/NOR,AF TUNE	S2,5,15	3
S40-2434-05	N	Push switch FULL/SEMI, MONI,VFO/MEMO, NB1,NB2	S3,4,18,21,22	5
S40-2435-05	N	Push switch A=B, MIN,MR	S17,19,20	3
S50-1409-05		Tact switch 1MHz STEP	S26,27	2
S50-1411-05	N	Tact switch BAND	S28–37	10
S51-1414-05	N	Lead relay ANT	RL2	1
S51-2412-15	N	Relay POWER	RL1	1
S90-0402-15	N	Slide switch MODE	S10	1

POWER SUPPLY UNIT (X43-1430-00)

Parts No.	Re marks	Description	Ref. No.	Q'ty
CE04W1E100M		E 10 25V	C11	1
CE04W1E101M		E 100 25V ●	C12	1
CE04W1E220M		E 22 25V ●	C13	1
CK45E2H472P		C 0.0047	C1,2	2
CK45F1H103Z		C 0.01	C5	1
CQ92M1H104K		ML 0.1	C7	1
C90-0858-05	N	E 2200 50V	C3,4	2
C90-0859-05	N	E 2200 35V	C6	1
C91-0456-05		C 0.047	C10	1
E40-0273-05		Mini connector 2P		3
E40-0373-05		Mini connector 3P		2
E40-0573-05		Mini connector 5P ●		1
F05-1534-05	N	Fuse 32V 15A		1
J31-0502-04		PC board collar		4
J42-0428-05		PC board bushing		4
L40-1511-03		Ferri-inductor 150μH	L1–3	3
N87-3012-46		Self tapping screw		4
R12-0427-05		Trim. pot. 500Ω(B)	VR1	1
RC05GF2H122J		Solid 1.2kΩ 1/2W	R19	1
RC05GF2H2R2J		Solid 2.2Ω 1/2W	R1,4,5	3
R92-0150-05		Short jumper		3

RF UNIT (X44-1490-00)

Parts No.	Re marks	Description	Ref. No.	Q'ty
C05-0030-15		Ceramic trimmer 20pF ○	TC1	1
CC45CH1H020C		C 2pF ●	C24	1
CC45RH1H050C		C 5pF	C7	1
CC45RH1H100D		C 10pF	C5,9,12	3
CC45RH1H100D		C 10pF ●	C23	1
CC45RH1H100D		C 10pF ○	C1	1
CC45RH1H560J		C 56pF ●	C22	1
CC45SL1H220J		C 22pF	C20	1
CC45SL1H470J		C 47pF ●	C1,21	2
CE04W1A470M		E 47 10V ○	C15	1
CE04W1E470M		E 47 25V	C3	1
CK45B1H102K		C 0.001	C10,11,19	3
CK45F1H103Z		C 0.01	C6,8,13,16–18	6
C91-0456-05		C 0.047	C2,4,14	3
C91-0456-05		C 0.047 ●	C15	1
E04-0157-05		Mini pin jack A		3
E29-0432-05	N	1P connector (female)		1
L19-0333-05	N	Wide bandwidth transf.	T1	1
L19-0334-05	N	Wide bandwidth transf.	T2	1
L19-0335-05	N	Wide bandwidth transf.	T6	1
L32-0199-05		OSC coil ○	T7	1
L34-0858-05		Tuning coil	T3,5	2
L34-2074-05	N	Tuning coil	T4	1
L34-2161-15		Tuning coil ●	T7	1
L40-1021-03		Ferri-inductor 1mH	L1,2	2
L40-4701-03		Ferri-inductor 47μH	L3–6	4
N87-3006-46		Self tapping screw		3
R12-0420-05		Trim. pot. 500Ω ●	VR1	1
R91-0150-05		Short jumper		3

PLL UNIT (X50-1880-00)

Parts No.	Re marks	Description	Ref. No.	Q'ty
C05-0030-15		Ceramic trimmer 20pF	TC3,4	2
C05-0044-05		Ceramic trimmer 30pF	TC1	1
C05-0309-05		Ceramic trimmer 40pF	TC2	1
CC45CH1H010C		C 1pF	C2,28,30,61	4
CC45CH1H020C		C 2pF	C63	1
CC45CH1H030C		C 3pF	C191	1
CC45CH1H050C		C 5pF	C62,144	2
CC45CH1H0R5C		C 0.5pF	C128,129,150, 151	4
CC45CH1H070D		C 7pF	C19	1
CC45CH1H080D		C 8pF	C101	1
CC45CH1H330J		C 33pF	C16,111	2
CC45RH1H050C		C 5pF	C127,146	2
CC45RH1H070D		C 7pF	C133,152	2
CC45RH1H150J		C 15pF	C147–149	3
CC45RH1H180J		C 18pF	C130–132	3
CC45RH1H220J		C 22pF	C27,29,31,114	4
CC45RH1H470J		C 47pF	C115	1
CC45RH1H560J		C 56pF	C113,143,145	3

PARTS LIST

Parts No.	Re-marks	Description	Ref. No.	Q'ty
CC45SL1H070D		C 7pF	C26,40,42,165,168	5
CC45SL1H100D		C 10pF	C23,99,116,117, 122,164	6
CC45SL1H101J		C 100pF	C32,180	2
CC45SL1H150J		C 15pF	C11	1
CC45SL1H151J		C 150pF	C17	1
CC45SL1H220J		C 22pF	C3,41,68,85,98, 166,167	7
CC45SL1H330J		C 33pF	C15,109,169	3
CC45SL1H560J		C 56pF	C194	1
CC45SL1H680J		C 68pF	C110	1
CC45UJ1H070D		C 7pF	C58	1
CC45UJ1H150J		C 15pF	C55	1
CC45UJ1H180J		C 18pF	C57,73	2
CC45UJ1H270J		C 27pF	C74	1
CC45UJ1H330J		C 33pF	C54,75	2
CC45UJ1H470J		C 47pF	C190	1
CC45UJ1H560J		C 56pF	C72	1
CE04W0J331M		E 330 6.3V	C14	1
CE04W1A101M		E 100 10V	C183	1
CE04W1A470M		E 47 10V	C8,70,84,176	4
CE04W1C101M		E 100 16V	C50,79	2
CE04W1C220M		E 22 16V	C53,67,76	3
CE04W1C470M		E 47 16V	C59	1
CE04W1H010M		E 1 50V	C5	1
CK45B1H102K		C 0.001	C21	1
CK45B1H222K		C 0.0022	C47,65,135	3
CK45B1H471K		C 470pF	C82,184,195,196	4
CK45F1H103Z		C 0.01	C13,18,20,22, 33–39,43–45,51, 52,56,60,64,71, 77,78,95,96,100, 102–108,112, 118–121,123–126, 134,136–142,153, 155–163,170–175, 177–179,188,189, 193	71
CQ92M1H123K		ML 0.012	C88,90	2
CQ92M1H222K		ML 0.0022	C6	1
CQ92M1H273K		ML 0.027	C89	1
CQ92M1H333K		ML 0.033	C10,48	2
CQ92M1H472K		ML 0.0047	C81	1
CQ92M1H473K		ML 0.047	C7,185	2
C91-0456-05		C 0.047	C1,4,9,12,24,25, 46,49,66,69,80, 83,86,87,91–94, 97,181,182,186, 187	23
E04-0154-05	N	Coax. connector		2
E23-0047-04		Square terminal		2
E40-0273-05		Mini connector 2P		2
E40-0373-05		Mini connector 3P		3
E40-0473-05		Mini connector 4P		1
E40-0873-05		Mini connector 8P		2
J31-0502-04		PC board collar		7
J42-0428-05		PC board bushing		7
L32-0196-05		OSC coil 20M	T14	1
L32-0649-05	N	OSC coil 50M	T15	1
L34-0709-05		Tuning coil 10M	T11,12	2
L34-0711-05		Tuning coil 14M	T7	1
L34-0712-05		Tuning coil 14M	T9	1
L34-0713-15		Tuning coil 14M	T8	1
L34-2075-05	N	Tuning coil 50M,60M	T1–6	6
L34-2076-05	N	Tuning coil 40M	T16–18	3
L34-2077-05	N	Tuning coil 8.83M	T13	1
L34-2078-05	N	Tuning coil 5M	T10	1
L40-1011-04		Ferri-inductor 100μH	L2,28	2
L40-1511-03		Ferri-inductor 150μH	L16,27,31	3
L40-2701-03		Ferri-inductor 27μH	L23,24	2
L40-4701-03		Ferri-inductor 47μH	L10–15,17,29,32	9
L40-4711-03		Ferri-inductor 470μH	L1,3–5,9,18–20, 25,26,30,35,36	13
L40-6825-04		Ferri-inductor 6.8mH	L21,22	2
L40-8291-02		Ferri-inductor 8.2μH	L6–8,33,34	5
L71-0233-05	N	MCF 8.8495MHz	MCF1,2	1A
L77-0720-05		Crystal 10.24MHz	X2	1
L77-0963-05	N	Crystal 20MHz	X1	1
R12-1408-05	N	Trim. pot. 4.7kΩ(B)	VR1,2	2
RC05GF2H390J		Solid 39Ω 1/2W	R81	1
R90-0536-05	N	Inline block 6.8kΩx6	IB1	1
R92-0150-05		Short jumper		31

LPF UNIT (X51-1280-00)

Parts No.	Re-marks	Description	Ref. No.	Q'ty
CC45SL1H101J		C 100pF	C91	1
CC45SL2H050C		C 5pF 500V	C56	1
CC45SL2H070D		C 7pF 500V	C57	1
CC45SL2H101J		C 100pF 500V	C1,7,18,26,37, 38,55,63	8
CC45SL2H120J		C 12pF 500V	C60	1
CC45SL2H121J		C 120pF 500V	C15,25,27	3
CC45SL2H150J		C 15pF 500V	C43,61	2
CC45SL2H151J		C 150pF 500V	C6,10,21,22,31, 42	6
CC45SL2H181J		C 180pF 500V	C14,30,41	3
CC45SL2H220J		C 22pF 500V	C4	1
CC45SL2H221J		C 220pF 500V	C9,17,50,58	4
CC45SL2H330J		C 33pF 500V	C3,8,99	3
CC45SL2H331J		C 330pF 500V	C13,19,20,28,47, 52	6
CC45SL2H390J		C 39pF 500V	C100	1
CC45SL2H391J		C 390pF 500V	C16,23,33	3
CC45SL2H470J		C 47pF 500V	C2,44,45,49,59	5
CC45SL2H471J		C 470pF 500V	C24	1
CC45SL2H560J		C 56pF 500V	C62	1
CC45SL2H680J		C 68pF 500V	C46	1
CC45SL2H681J		C 680pF 500V	C36	1
CE04W1A221M		E 220 10V	C72	1
CK45F1H103Z		C 0.01	C74–78,80–86, 106	13
CK45F1H473Z		C 0.047	C66	1
CM93D2H102J		MC 0.001 500V	C51	1

PARTS LIST

Parts No.	Re-marks	Description	Ref. No.	Q'ty
CM93D2H152J		MC 0.0015 500V	C29	1
CM93D2H222J		MC 0.0022 500V	C32	1
CM93D2H821J		MC 820pF 500V	C35	1
C91-0456-05		C 0.047	C64,65,67–71,73	8
E04-0154-05		Coax. connector		3
E23-0401-05		Round terminal		8
E40-0273-05		Mini connector 2P		1
E40-0373-05		Mini connector 3P		2
E40-0473-05		Mini connector 4P		1
E40-0573-05		Mini connector 5P		2
L34-3038-05	N	Filter coil A 1.5–2.5	L9	1
L34-3039-05	N	Filter coil B 1.5–2.5	L8	1
L34-3040-05	N	Filter coil C 2.5–4.0	L12	1
L34-3041-05	N	Filter coil D 2.5–4.0	L13	1
L34-3042-05	N	Filter coil E 4.0–6.0	L6,7	2
L34-3043-05	N	Filter coil F 6.0–10.5	L3–5	3
L34-3046-05	N	Filter coil I 10.5–15.5	L10	1
L34-3047-05	N	Filter coil J 10.5–15.5	L11	1
L34-3048-15	N	Filter coil K 15.5–22.0	L14,15	2
L34-3050-05	N	Filter coil M 22.0–30.0	L1	1
L34-3051-15	N	Filter coil N 22.0–30.0	L2	1
L39-0414-05	N	Detector coil	L27,28	2
L40-1011-03		Ferri-inductor 100μH	L31,34–40	8
L40-1011-04		Ferri-inductor 100μH	L22	1
L40-1021-03		Ferri-inductor 1mH	L24,25	2
L40-1511-03		Ferri-inductor 150μH	L16–21,26	7
L40-4791-02		Ferri-inductor 4.7μH	L30	1
N30-3006-41		Round screw		2
N32-3006-41		Flat screw		2
N87-3006-46		Self tapping screw		12
RC05GF2H101J		Solid 100Ω 1/2W	R48–51	4
RC05GF2H121J		Solid 120Ω 1/2W	R53	1
RC05GF2H182J		Solid 1.8kΩ 1/2W	R30	1
RC05GF2H2R2J		Solid 2.2Ω 1/2W	R58–61	4
RC05GF2H681J		Solid 680Ω 1/2W	R17,18	2
RC05GF2H821J		Solid 820Ω 1/2W	R19,20	2
R90-0535-05	N	Resistor block 22kΩ×7	RB1,2	2
R92-0150-05		Short jumper		14
S51-1412-05	N	Relay	RL1–14	14

DIGITAL UNIT (X54-1670-00)

Parts No.	Re-marks	Description	Ref. No.	Q'ty
CC45SL1H101J		C 100pF	C15,44–46	4
CC45SL1H220J		C 22pF	C36,37	2
CC45SL1H221J		C 220pF	C39	1
CE04W0J221M		E 220 6.3V	C8,14,19	3
CE04W1A470M		E 47 10V	C21,24,42	3
CE04W1C101M		E 100 16V	C11	1
CE04W1C220M		E 22 16V	C12	1
CE04W1C471M		E 470 16V	C9	1
CE04W1E331M		E 330 25V	C6	1
CE04W1H010M		E 1 50V	C23,25	2
CE04W1H100M		E 10 50V	C2,5,40	3
CE04W1H220M		E 22 50V	C3,4	2
CK45B1H102K		C 0.001	C1,16,26–31	8
CK45F1H103Z		C 0.01	C20,50	2
CQ92M1H272K		ML 0.0027	C38	1
C90-0824-05		E 1 50V	C47–49	3
C91-0456-05		C 0.047	C7,10,13,17,18, 22,32–35,41,43	12
E29-0413-05		1P connector (female)		1
E40-0273-05		Mini connector 2P		1
E40-0373-05		Mini connector 3P		2
E40-0473-05		Mini connector 4P		2
E40-0673-05		Mini connector 6P		1
E40-0773-05		Mini connector 7P		2
E40-0873-05		Mini connector 8P		4
E40-1073-05		Mini connector 10P		1
E40-1173-05		Mini connector 11P		1
E40-1273-05		Mini connector 12P		2
J31-0502-04		PC board collar		6
J42-0404-05		PC board bushing		6
L19-0336-05	N	DC-DC transf.	T1	1
L40-1011-04		Ferri-inductor 100μH	L1–4	4
L40-1021-03		Ferri-inductor 1mH	L5–11	7
L77-0964-05	N	Crystal 5.59MHz	X1	1
N35-3006-46		Bind screw		2
N88-3008-46		Flat tapping screw		2
R90-0158-05	N	Inline block 47kΩ×7	RB3	1
R90-0162-05	N	Inline block 47kΩ×8	RB4	1
R90-0537-05	N	Inline block 10kΩ×8	RB5	1
R90-0538-05	N	Inline block 1.5kΩ×3	RB1	1
R90-0539-05	N	Inline block 47kΩ×6	RB6,7	2
R90-0542-05	N	Inline block 47kΩ×12	RB9	1
R90-0543-05	N	Inline block 47kΩ×11	RB2,8	2
R90-0544-05	N	Inline block 0.01×3	CB3	1
R90-0545-05	N	Inline block 0.01×5	CB1	1
R90-0546-05	N	Inline block 0.01×7	CB4	1
R90-0547-05	N	Inline block 0.01×12	CB2	1
R90-0548-05	N	Inline block 0.022×7	CB5	1
R90-0549-05	N	Inline block 0.022×8	CB6	1
R90-0550-05	N	Inline block 0.022×11	CB7	1

PARTS LIST

MAIN ENCODER UNIT (X54-1680-00)

Parts No.	Re marks	Description	Ref. No.	Q'ty
CE04W0J221M		E 220 6.3V	C1	1
CE04W0J470M		E 47 6.3V	C2	1
D09-0304-04		Encoder slit		1
D21-0823-05	N	Shaft ass'y		1
E23-0015-04		Earth lug		2
G02-0519-04		Spring plate		1
J19-1342-04		Senser mounting hardware (A)		1
J19-1343-04		Senser mounting hardware (B)		1
N30-3006-46		Round screw		4
N32-3020-46		Flat screw		1
N89-3005-46		Bind tapping screw		3
R12-2409-05		Trim. pot. 5kΩ(B)	VR1,2	2

RIT ENCODER UNIT (X54-1690-00)

Parts No.	Re marks	Description	Ref. No.	Q'ty
CE04W0J101M		E 100 6.3V	C1	1
D09-0305-04	N	Encoder slit		1
D21-0824-05	N	Shaft ass'y		1
N30-2606-46		Round screw		2
R12-2409-05		Trim. pot. 5kΩ(B)	VR1,2	2

100W FINAL UNIT (X56-1430-00)

Parts No.	Re marks	Description	Ref. No.	Q'ty
CC45SL1H271J		C 270pF	C35	1
CC45SL1H331J		C 330pF	C2,9	2
CC45SL2H101J		C 100pF 500V	C8,40,42	3
CE04W1A471M		E 470 10V	C18	1
CE04W1H100M		E 10 50V	C12	1
CE04W1H101M		E 100 50V	C24	1
CK45B1H102K		C 0.001	C4,10,19,23,39	5
CK45F1H473Z		C 0.047	C6,7,15,22	4
CM73F2H331J	N	MC 330pF 500V	C33	1
CM73F2H391J	N	MC 390pF 500V	C38	1
CM73F2H681J	N	MC 680pF 500V	C28	1
CQ92M1H473K		ML 0.047	C21	1
C91-0456-05		C 0.047	C1,3,5,11,13,14,20,25–27,36,37	12
C91-0491-05	N	Cap. 0.0047	C16,17	2
C91-0493-05	N	Cap. 0.47	C29,30	2
E04-0157-05		Mini pin jack A		2
E23-0433-05	N	Terminal		8
E40-0373-05		Mini connector 3P		1
F01-0771-15	N	Heat sink		1
F07-0839-03	N	Heat sink cover		1
F09-0405-24		Fan		1
F20-0078-05	N	Insulating sheet		6
F29-0014-05		Shoulder washer		10
F29-0406-03		Fan motor ass'y		1
L19-0337-05	N	Input transf.	T3	1
L19-0338-05	N	Input matching transf.	T2	1
L19-0339-05	N	Output transf. B	T4	1
L19-0340-05	N	RF transf. A	T1	1
L33-0025-05		RFC 1μH	L4,5	2
L33-0032-05		RFC 3μH	L2	1
L33-0617-05		RFC	L3,7–9	4
L33-0644-05		Choke coil 2.2μH	L17	1
L33-0651-05	N	Choke coil	L14,15	2
L33-0653-05	N	Choke coil	L16	1
L33-0655-05	N	RFC	L13	1
L40-1011-04		Ferri-inductor 100μH	L10	1
L40-1511-03		Ferri-inductor 150μH	L6,11,12,18	4
N09-0623-04		Sems screw		5
N09-0643-04	N	Sems screw w. cross head		1
N09-0658-04		Round screw Fan motor		2
N15-1030-41		Washer Fan motor		4
N30-2604-41		Round screw Fan motor		5
N30-3006-46		Round screw Thermistor		1
N35-3008-46		Round screw TR		4
N87-3006-46		Self tapping screw PC board		4
N89-3006-45		Bind tapping screw Cover		10
R12-0072-05		Trim. pot. 470Ω(B)	VR1	1
R12-1406-05		Trim. pot. 1kΩ(B)	VR2	1
RC05GF2H151J		Solid 150Ω 1/2W	R7	1
RC05GF2H220J		Solid 22Ω 1/2W	R9,10	2
RC05GF2H221J		Solid 220Ω 1/2W	R11,12	2
RC05GF2H3R9J		Solid 3.9Ω 1/2W	R23–26	4
RC05GF2H4R7J		Solid 4.7Ω 1/2W	R6	1
RC05GF2H5R6J		Solid 5.6Ω 1/2W	R27–30	4
RC05GF2H560J		Solid 56Ω 1/2W	R34	1
RS14AB3D330J		MF 33Ω 2W	R35	1
R92-0041-25		Cement 0.47Ω 1W	R21	1
R92-0150-05		Short jumper		3
T42-0302-05	N	Fan motor		1

PARTS LIST

Parts No.	Re-marks	Description	Ref. No.	Q'ty
SIGNAL UNIT (X57-1000-11) From S/N208XXXX–309XXXX				
C05-0013-15		Ceramic trimmer 20pF	TC3–6	4
C05-0030-15		Ceramic trimmer 20pF	TC1	1
C05-0314-05		Ceramic trimmer 100pF	TC2	1
C05-0320-05		Ceramic trimmer 30pF	TC7	1
CC45CH1H010C		C 1pF	C255	1
CC45CH1H020C		C 2pF	C471	1
CC45CH1H030C		C 3pF	C105,125,142,280,473	5
CC45CH1H050C		C 5pF	C476	1
CC45CH1H0R5C		C 0.5pF	C199,249,356,359,477	5
CC45CH1H070D		C 7pF	C106	1
CC45CH1H100D		C 10pF	C6,128,132,144,310	5
CC45CH1H150J		C 15pF	C320,469	2
CC45CH1H220J		C 22pF	C340,454,456,458,364	5
CC45RH1H010C		C 1pF	C107,121	2
CC45RH1H020C		C 2pF	C108,197,212	3
CC45RH1H030C		C 3pF	C178	1
CC45RH1H050C		C 5pF	C264	1
CC45RH1H070D		C 7pF	C184,267	2
CC45RH1H100D		C 10pF	C113–115	3
CC45RH1H101J		C 100pF	C51,66,398,308	4
CC45RH1H120J		C 12pF	C93,96,97,263,265,296	6
CC45RH1H121J		C 120pF	C14,54,185,187,552	5
CC45RH1H180J		C 18pF	C186	1
CC45RH1H181J		C 180pF	C45,47	2
CC45RH1H220J		C 22pF	C76,78,92,98,266	5
CC45RH1H221J		C 220pF	C39,41	2
CC45RH1H241J		C 240pF	C301,309,553	3
CC45RH1H270J		C 27pF	C91,358	2
CC45RH1H330J		C 33pF	C348,411	2
CC45RH1H390J		C 39pF	C70,72	2
CC45RH1H470J		C 47pF	C65	1
CC45RH1H560J		C 56pF	C16,53,55,64,71,77,370	7
CC45RH1H680J		C 68pF	C52	1
CC45RH1H820J		C 82pF	C10	1
CC45SL1H050C		C 5pF	C158,252	2
CC45SL1H100D		C 10pF	C159,336,468,478	4
CC45SL1H101J		C 100pF	C218,283,298,331,352,369,380,393,466,485,487,511,540,574,606,654	16
CC45SL1H120J		C 12pF	C641,647	2
CC45SL1H121J		C 120pF	C24	1
CC45SL1H150J		C 15pF	C244,377	2
CC45SL1H151J		C 150pF	C338,365,373,376,498,520,528	7
CC45SL1H220J		C 22pF	C279,483	2
CC45SL1H221J		C 220pF	C335	1
CC45SL1H330J		C 33pF	C254	1
CC45SL1H331J		C 330pF	C28,162,164,653	4
CC45SL1H391J		C 390pF	C46,622	2
CC45SL1H470J		C 47pF	C15,67,138,278,313,472,530,656,657	9
CC45SL1H680J		C 68pF	C13,59	2
CC45SL1H820J		C 82pF	C58,60	2
CC45TH1H030C		C 3pF	C349,462	2
CC45TH1H220J		C 22pF	C94	1
CC45TH1H270J		C 27pF	C99	1
CC45TH1H330J		C 33pF	C116	1
CC45TH1H680J		C 68pF	C464	1
CE04AW1H0R1M		E 0.1 50V	C386,510,534,542,578	5
CE04AW1HR22M		E 0.22 50V	C86,171,486,509,636	5
CE04W1A101M		E 100 10V	C488	1
CE04W1C100M		E 10 16V	C537,630	2
CE04W1C102M		E 1000 16V	C651	1
CE04W1C220M		E 22 16V	C151,167,221,225,226,282,344,392,396,450,505,567–569,576,583,587,631,632	19
CE04W1C221M		E 220 16V	C640	1
CE04W1C470M		E 47 16V	C222,345,346,391,395,536,642,648	8
CE04W1E100M		E 10 25V	C112,220,285,343,384,387,389,543,564,571,586,629,633,634,639,644,652	17
CE04W1E220M		E 22 25V	C20,22,31,38,44,50,57,63,69,74 88	11
CE04W1E471M		E 470 25V	C440,441	2
CE04W1H010M		E 1 50V	C154,191,390,420,423,424,426,427,432,492,525,541,563,565,588,599,628,638	18
CE04W1H3R3M		E 3.3 50V	C388,449,566,575	4
CE04W1HR47M		E 0.47 50V	C153,385,501,591,592	5
CE04W1H4R7M		E 4.7 50V	C176,179,500	3
CK45B1H102K		C 0.001	C122,127,140,148,152,161,163,177,207,400,401,436,490,532,562,600,645,646	18
CK45B1H181K		C 180pF	C100	1
CK45B1H221K		C 220pF	C412,531,595,596,618	5
CK45B1H222K		C 0.0022	C227,228,533,549,614,623	6
CK45B1H331K		C 330pF	C465	1
CK45B1H391K		C 390pF	C32,34	2
CK45B1H471K		C 470pF	C339,353,434	3
CK45B1H681K		C 680pF	C33,330,394,570	4
CK45B1H821K		C 820pF	C23,29,40	3
CK45E2H102P		C 0.001 500V	C135	1

PARTS LIST

Parts No.	Re-marks	Description	Ref. No.	Q'ty
CK45F1H103Z		C 0.01	C7,11,12,17,90,95, 102,104,111,117,118, 120,123,129,134,141, 143,145,146,166,172, 173,174,183,194,195, 208,209,219,236,237, 241,242,253,262,269, 271,277,281,284,324, 351,355,361,367,378, 413,430,435,437,439, 443,444,452,453,455, 457,459,461,475,493, 497,515,521,527,535, 539,544,547,559,561, 577,584,607–609, 655	77
CQ09S1H122J		S 0.0012	C402–404	3
CQ09S1H182J		S 0.0018	C518,519	2
CQ09S1H392J		S 0.0039	C554,610	2
CQ92M1H102K		ML 0.001	C26,170,213	3
CQ92M1H103K		ML 0.01	C168,447,448,451	4
CQ92M1H104K		ML 0.1	C643	1
CQ92M1H152K		ML 0.0015	C25,27,616	3
CQ92M1H222K		ML 0.0022	C545,546,637	3
CQ92M1H223K		ML 0.022	C215,229,230,232, 446,538,572,649	8
CQ92M1H332K		ML 0.0033	C579–581	3
CQ92M1H392K		ML 0.0039	C512,615	2
CQ92M1H472K		ML 0.0047	C110,589	2
CQ92M1H473K		ML 0.047	C214,216,217,231, 233–235,491,582, 598,625,635	12
CQ92M1H562K		ML 0.0056	C224,590	2
CQ92M1H682K		ML 0.0068	C626,627	2
C90-0817-05		E 1000 16V	C119	1
C91-0456-05		C 0.047	C8,9,18,19,21,30, 37,42,43,48,49,62, 80–85,87,89,109, 149,156,157,165,175, 180–182,190,192, 193,210,223,245,248, 256,258,259,274,295, 297,300,311, 314–317,325,327,329 332–334,341,342, 347,362,366,368,372, 374,375,379, 381–383,397,399, 414–418,421,422, 425,428,429,433,438, 463,480,482,484,489, 494–496,499,513, 514,516,517, 522–524,529,548, 550,551,555–558, 560,585,593,594,597, 611–613,617, 619–621,624	118

Parts No.	Re-marks	Description	Ref. No.	Q'ty
C91-0457-05		C 0.022	C56,61,68,73,75 79,124,126,130, 131,133,136,137, 139,150,155,160, 238–240,243,246 247,250,251,257 260,261,270,272, 273,276,286–294, 299,312,318, 321–323,326,328, 337,350,354,357, 360,363,419,431, 442,445,460,467, 470,474,479,481	65
C91-0458-05		Laminated cap. 0.47	C169	1
C91-0472-05		ML 0.1	C211	1
E04-0154-05		Coax. connector		8
E23-0512-05		Round terminal		1
E40-0273-05		Mini connector 2P		12
E40-0373-05		Mini connector 3P		2
E40-0473-05		Mini connector 4P		5
E40-0511-05		Mini connector 5P	MC1–6	6
E40-0517-05		Mini connector 5P	MB1,2	2
E40-0573-05		Mini connector 5P		1
E40-0673-05		Mini connector 6P		4
E40-0773-05		Mini connector 7P		1
E40-0873-05		Mini connector 8P		3
E40-1073-05		Mini connector 10P		2
E40-1173-05		Mini connector 11P		1
F20-0525-05		Insulating sheet		3
F29-0014-05		Shoulder washer		3
L19-0324-05		Wide bandwidth transf.	L13,51,93	3
L30-0516-05	N	IFT	L140	1
L32-0201-05		OSC coil CAR1,CAR2	L139,161	2
L32-0650-15	N	OSC coil 100kHz	L166,169,172, 173	4
L32-0651-05	N	OSC coil VCO-L	L54	1
L32-0652-05	N	OSC coil VCO-M	L53	1
L32-0653-05	N	OSC coil VCO-H	L52	1
L33-0656-05	N	Choke coil 25μH	L160	1
L33-0657-05	N	Choke coil 27μH	L137	1
L34-0535-05		Tuning coil	L80,111,115	3
L34-0536-05		Tuning coil 8.83MHz	L81,113,126,143	4
L34-0540-05		Tuning coil	L135,136,144, 145,152	5
L34-0664-05		Tuning coil 455kHz	L130,153	2
L34-0858-05		Tuning coil	L124	1
L34-0859-05		Tuning coil	L121,123	2
L34-0860-15		Tuning coil	L122	1
L34-0941-05		Tuning coil 8.83MHz	L127	1
L34-0943-05		Tuning coil	L99,125,129,133	4
L34-0997-05		Tuning coil	L128	1
L34-2079-05	N	Tuning coil	L11	1
L34-2080-05	N	Tuning coil	L12	1
L34-2081-05	N	Tuning coil	L15	1
L34-2082-05	N	Tuning coil	L16	1
L34-2083-05	N	Tuning coil	L18	1
L34-2085-05	N	Tuning coil	L22	1
L34-2086-05	N	Tuning coil	L23	1
L24-2087-05	N	Tuning coil	L24	1
L34-2088-05	N	Tuning coil	L25	1

PARTS LIST

Parts No.	Re marks	Description	Ref. No.	Q'ty
L34-2089-05	N	Tuning coil	L26	1
L34-2090-05	N	Tuning coil	L27	1
L34-2091-05	N	Tuning coil	L29	1
L34-2092-05	N	Tuning coil	L30	1
L34-2093-05	N	Tuning coil	L31,32	2
L34-2094-05	N	Tuning coil	L33	1
L34-2095-15	N	Tuning coil	L34	1
L34-2096-05	N	Tuning coil	L35	1
L34-2097-05	N	Tuning coil	L17	1
L34-2098-05	N	Tuning coil	L19	1
L34-2099-05	N	Tuning coil	L38,39	2
L34-2100-25	N	Tuning coil	L40	1
L34-2101-05	N	Tuning coil	L41	1
L34-2102-25	N	Tuning coil	L42	1
L34-2103-15	N	Tuning coil	L43	1
L34-2104-05	N	Tuning coil	L44	1
L34-2105-15	N	Tuning coil	L45	1
L34-2106-05	N	Tuning coil	L66,68	2
L34-2107-05	N	Tuning coil	L67	1
L34-2108-15	N	Tuning coil	L77	1
L34-2109-15	N	Tuning coil	L84	1
L34-2111-05	N	Tuning coil	L88,92	2
L34-2112-05	N	Tuning coil	L89,91	2
L34-2113-05	N	Tuning coil	L90	1
L34-2114-15	N	Tuning coil 44.93MHz	L94	1
L34-2115-15	N	Tuning coil 44.93MHz	L95	1
L34-2116-15	N	Tuning coil 44.93MHz	L96,97	2
L34-2117-15	N	Tuning coil	L98	1
L34-2118-15	N	Tuning coil 8.83MHz	L112	1
L34-2121-05	N	Tuning coil 455kHz	L131	1
L34-2122-05	N	Tuning coil 455kHz	L134	1
L34-2123-15	N	Tuning coil	L132,142	2
L34-2124-05	N	Tuning coil 455kHz	L165	1
L34-2125-15	N	Tuning coil 355kHz	L146–148	3
L34-2127-15	N	Tuning coil	L167	1
L34-2128-15	N	Tuning coil	L168	1
L34-2129-05	N	Tuning coil	L175	1
L40-1011-03		Ferri-inductor 100μH	L83	1
L40-1011-04		Ferri-inductor 100μH	L82,87,101	3
L40-1021-03		Ferri-inductor 1mH	L149–151	3
L40-1511-03		Ferri-inductor 150μH	L2,118,119	3
L40-1541-27		Ferri-inductor 150mH	L170,171	2
L40-1811-03		Ferri-inductor 180μH	L86	1
L40-2201-03		Ferri-inductor 22μH	L55,56	2
L40-2291-02		Ferri-inductor 2.2μH	L36	1
L40-2701-03		Ferri-inductor 27μH	L57,58	2
L40-3301-03		Ferri-inductor 33μH	L59,60	2
L40-3391-03		Ferri-inductor 3.3μH	L174	1
L40-4701-03		Ferri-inductor 47μH	L65,69–73,76, 78,79	9
L40-4701-11		Ferri-inductor 47μH	L120	1
L40-4711-03		Ferri-inductor 470μH	L46–50,61–64,74, 75,100,114,116, 117,138,141,154–159, 162–164,176	27
L40-4725-04		Ferri-inductor 4.7mH	L14	1
L40-4791-02		Ferri-inductor 4.7μH	L10,37	2
L40-5691-02		Ferri-inductor 5.6μH	L85	1
L40-8291-02		Ferri-inductor 8.2μH	L28	1
L71-0234-05	N	MCF 44.93MHz	XF1,2	1A
L71-0235-05	N	MCF 8.830MHz	XF3	1
L72-0319-05		Ceramic filter 455kHz	CF2	1
L72-0334-05	N	Ceramic filter 455kHz	CF1	1
L77-0965-15	N	Crystal 36.1MHz	X1	1
L77-0966-05	N	Crystal 8375kHz	X2	1
L77-0967-05	N	Crystal 8828.5kHz	X4	1
L77-0968-05	N	Crystal 8830kHz	X5	1
L77-0969-05	N	Crystal 8831.5kHz	X3	1
N10-2030-41		Nut		6
N30-3008-41		Round screw		4
N30-3010-41		Round screw		8
N87-3006-41		Self tapping screw		3
R12-0401-05		Trim. pot. 100Ω	VR21	1
R12-0420-05		Trim. pot. 500Ω	VR2,6	2
R12-0430-05	N	Trim. pot. 470Ω	VR3–5	3
R12-1405-05		Trim. pot. 1kΩ	VR18	1
R12-1424-05	N	Trim. pot. 4.7kΩ	VR23,24,27	3
R12-2409-05		Trim. pot. 5kΩ	VR1	1
R12-3411-05		Trim. pot. 47kΩ	VR8–10,15,16 26,32–34	9
R12-3413-05		Trim. pot. 10kΩ	VR11,13,25,30	4
R12-3430-05		Trim. pot. 10kΩ	VR22	1
R12-3438-05	N	Trim. pot. 22kΩ	VR7,28,29	3
R12-5414-05	N	Trim. pot. 100kΩ	VR12,17,31	3
R12-5415-05	N	Trim. pot. 150kΩ	VR20	1
R12-6404-05		Trim. pot. 470kΩ	VR14,19	2
RN14BK2E103F		MF 10kΩ 1/4W	R277	1
RN14BK2E271F		MF 270Ω 1/4W	R519,520	2
RN14BK2E333F		MF 33kΩ 1/4W	R272,275	2
RN14BK2E912F		MF 9.1kΩ 1/4W	R273	1
RN14BK2E1503F		MF 150kΩ 1/4W	R276	1
RS14AB3A331J		MF 330Ω 1W	R20	1
R90-0163-05	N	Inline block 47kΩx9	IB1	1
R90-0549-05	N	Inline block 0.022 x 8	IB4	1
R90-0551-05	N	Inline block 0.01x4	IB2,3	2
R90-0553-05	N	Inline block	IB5	1
R92-0150-05		Short jumper		157
S51-1404-05		Relay	RL1–3	3

SIGNAL UNIT (X57-1000-11) From S/N310XXXX–

C05-0013-15		Ceramic trimmer 20pF	TC3–6	4
C05-0030-15		Ceramic trimmer 20pF	TC1	1
C05-0314-05		Ceramic trimmer 100pF	TC2	1
CC45CH1H010C		C 1pF	C255,476	2
CC45CH1H020C		C 2pF	C471	1
CC45CH1H030C		C 3pF	C105,125,142, 280,469	5
CC45CH1H0R5C		C 0.5pF	C199,249,356, 359,473,477	6
CC45CH1H070D		C 7pF	C106	1
CC45CH1H100D		C 10pF	C6,128,132,144, 310	5
CC45CH1H150J		C 15pF	C254	1
CC45CH1H220J		C 22pF	C454,456,458, 364	4

PARTS LIST

Parts No.	Re marks	Description	Ref. No.	Q'ty
CC45RH1H010C		C 1pF	C107,121	2
CC45RH1H020C		C 2pF	C108,197,212	3
CC45RH1H030C		C 3pF	C178	1
CC45RH1H050C		C 5pF	C264	1
CC45RH1H070D		C 7pF	C184,267	1
CC45RH1H100D		C 10pF	C113–115	3
CC45RH1H101J		C 100pF	C51,66,398	3
CC45RH1H120J		C 12pF	C93,96,97,263, 256,296	6
CC45RH1H121J		C 120pF	C14,54,185,187, 552	5
CC45RH1H180J		C 18pF	C186	1
CC45RH1H181J		C 180pF	C45,47	2
CC45RH1H220J		C 22pF	C76,78,92,98 266,319,320	7
CC45RH1H221J		C 220pF	C39,41	2
CC45RH1H241J		C 240pF	C301,309,553	3
CC45RH1H270J		C 27pF	C91,358	2
CC45RH1H330J		C 33pF	C348,411	2
CC45RH1H390J		C 39pF	C70,72	2
CC45RH1H470J		C 47pF	C65	1
CC45RH1H560J		C 56pF	C16,53,55,64, 71,77,370	7
CC45RH1H680J		C 68pF	C52	1
CC45RH1H820J		C 82pF	C10	1
CC45SL1H050C		C 5pF	C158,252	2
CC45SL1H100D		C 10pF	C159,336,468, 478	4
CC45SL1H101J		C 100pF	C218,283,298, 308,331,352,369, 380,393,466,483, 485,511,540,574, 606,654	17
CC45SL1H120J		C 12pF	C641,647	2
CC45SL1H121J		C 120pF	C24	1
CC45SL1H150J		C 15pF	C377	1
CC45SL1H151J		C 150pF	C338,365,373, 376,498,520,528	7
CC45SL1H220J		C 22pF	C279	1
CC45SL1H221J		C 220pF	C335	1
CC45SL1H330J		C 33pF	C254	1
CC45SL1H331J		C 330pF	C28,162,164, 653	4
CC45SL1H391J		C 390pF	C46,622	2
CC45SL1H470J		C 47pF	C15,67,138,278, 313,472,530,657	8
CC45SL1H680J		C 68pF	C13,59	2
CC45SL1H820J		C 82pF	C58,60	2
CC45TH1H030C		C 3pF	C349,462	2
CC45TH1H220J		C 22pF	C94	1
CC45TH1H270J		C 27pF	C99	1
CC45TH1H330J		C 33pF	C116	1
CC45UJ1H820J		C 82pF	C464	1
CE04AW1H0R1M		E 0.1 50V	C385,386,510, 534,542,578	6
CE04AW1HR22M		E 0.22 50V	C86,171,509,636	4
CE04W1HR33M		E 0.33 50V	C355,459	2
CE04W1A101M		E 100 10V	C488	1
CE04W1C100M		E 10 16V	C396,537,630	3
CE04W1C101M		E 100 16V	C525	1
CE04W1C102M		E 1000 16V	C651	1

Parts No.	Re marks	Description	Ref. No.	Q'ty
CE04W1C220M		E 22 16V	C151,167,221, 225,226,282,344, 392,396,450,505, 567–596,576, 583,587,631,632	19
CE04W1C221M		E 220 16V	C640	1
CE04W1C470M		E 47 16V	C222,345,346, 391,395,536,613, 642,648	9
CE04W1E100M		E 10 25V	C112,220,285, 343,384,387,389, 543,564,571,586, 629,633,634,639, 644,652	17
CE04W1E220M		E 22 25V	C20,22,31,38,44, 50,57,63,69,74, 88	11
CE04W1E471M		E 470 25V	C440,441	2
CE04W1H010M		E 1 50V	C154,191,375, 390,420,423,424, 426,427,432,486, 492,494,541,563, 565,588,599,628, 638	20
CE04W1H3R3M		E 3.3 50V	C388,449,566, 575	4
CE04W1HR47M		E 0.47 50V	C153,101,501, 591,592	5
CE04W1H4R7M		E 4.7 50V	C176,179,500	3
CK45B1H102K		C 0.001	C17,122,127,140, 146,148,152,161, 163,177,207,367, 371,400,401,436, 487,490,532,562, 600,645,646	23
CK45B1H181K		C 180pF	C100	1
CK45B1H221K		C 220pF	C531,595,596, 618	4
CK45B1H222K		C 0.0022	C227,228,533, 549,614,623	6
CK45B1H331K		C 330pF	C412,465	2
CK45B1H391K		C 390pF	C32,34	2
CK45B1H471K		C 470pF	C339,353,434	3
CK45B1H681K		C 680pF	C33,330	2
CK45B1H821K		C 820pF	C23,29,40	3
CK45E2H102P		C 0.001 500V	C135	1
CK45F1H103Z		C 0.01	C1,7,11,12,95,102, 104,111,117,118, 120,123,129,134, 141,143,145,166, 172–174,183, 194,195,208,209, 219,236,237,242, 253,262,269,271, 277,281,284,324, 351,361,378,413, 430,435,437,439, 443,444,452,453, 455,457,461,475, 493,497,515,521, 527,535,539,544, 559,561,577,584, 607–609,655	70

PARTS LIST

Parts No.	Re marks	Description	Ref. No.	Q'ty
CQ09S1H122J		S 0.0012	C402–404	3
CQ09S1H182J		S 0.0018	C518,519	2
CQ09S1H392J		S 0.0039	C544,610	2
CQ92M1H102K		ML 0.001	C26,170,	2
CQ92M1H103K		ML 0.01	C168,447,448,451	4
CQ92M1H104K		ML 0.1	C643	1
CQ92M1H152K		ML 0.0015	C25,27,616	3
CQ92M1H222K		ML 0.0022	C546,637	2
CQ92M1H223K		ML 0.022	C215,229,230,232, 446,538,572,649	8
CQ92M1H332K		ML 0.0033	C394,570,579–581	5
CQ92M1H392K		ML 0.0039	C512,615	2
CQ92M1H472K		ML 0.0047	C110,589	2
CQ92M1H473K		ML 0.047	C214,216,217,231, 233–235,491,582, 598,625,635	12
CQ92M1H562K		ML 0.0056	C224,590	2
CQ92M1H682K		ML 0.0068	C626,627	2
C90-0817-05		E 10000 16V	C119	1
C90-0878-05		T 1 35V	C700–702	3
C91-0456-05		C 0.047	C2,5,8,9,18,19,21,30, 37,42,43,48,49,62, 80–85,87,89,109,149, 156,157,165,175,180–182,190,192,193,206, 210,223,245,248,256, 258,259,274,295,297, 300,302,311,314–317, 325,327,329,332–334, 341,342,347,362,366, 368,372,374,379,381–383,397,399,405,414–418,421,422,425,428, 429,433,438,463,480, 482,484,489,495,496, 499,508,513,514,516, 517,522–524,526,529, 548,550,551,555–558, 560,585,593,594,597, 605,611,612,617,619, 621,624	122
C91-0457-05		C 0.022	C56,61,68,73,75 79,124,126,130, 131,133,136,137, 139,150,155,160, 238–240,243,246, 247,250,251,257, 260,261,270,272, 273,276,286–294, 299,312,318, 321–323,328,337, 350,354,357,360, 363,419,431,442, 445,460,467,470, 474,479,481	64
C91-0458-05		Laminated cap. 0.47	C169	1
C91-0472-05		ML 0.1	C211	1
E04-0154-05		Coax. connector		8
E23-0512-05		Round terminal		1
E40-0273-05		Mini connector 2P		12

Parts No.	Re marks	Description	Ref. No.	Q'ty
E40-0373-05		Mini connector 3P		2
E40-0473-05		Mini connector 4P		5
E40-0511-05		Mini connector 5P	MC1–6	6
E40-0517-05		Mini connector 5P	MB1,2	2
E40-0573-05		Mini connector 5P		1
E40-0673-05		Mini connector 6P		4
E40-0773-05		Mini connector 7P		1
E40-0873-05		Mini connector 8P		3
E40-1073-05		Mini connector 10P		2
E40-1173-05		Mini connector 11P		1
F11-0813-04	N	Shield cover	CAR1	1
F20-0525-05		Insulating sheet		3
F29-0014-05		Shoulder washer		3
L19-0324-05		Wide bandwidth transf.	L13,51,93	3
L30-0516-05	N	IFT	L140	1
L32-0201-05		OSC coil CAR1,CAR2	L139,161	2
L32-0650-15	N	OSC coil 100kHz	L166,169,172, 173	4
L32-0651-05	N	OSC coil VCO-L	L54	1
L32-0652-05	N	OSC coil VCO-M	L53	1
L32-0653-05	N	OSC coil VCO-H	L52	1
L33-0656-05	N	Choke coil 25μH	L160	1
L33-0657-05	N	Choke coil 27μH	L137	1
L34-0535-05		Tuning coil	L80,111,115	3
L34-0536-05		Tuning coil 8.83MHz	L81,113,126,143	4
L34-0540-05		Tuning coil	L135,136,144, 145,152	5
L34-0664-05		Tuning coil 455kHz	L130,153	2
L34-0858-05		Tuning coil	L124	1
L34-0859-05		Tuning coil	L121,123	2
L34-0860-15		Tuning coil	L122	1
L34-0941-05		Tuning coil 8.83MHz	L127	1
L34-0943-05		Tuning coil	L99,125,129,133	4
L34-0997-05		Tuning coil	L128	1
L34-2079-05	N	Tuning coil	L11	1
L34-2080-05	N	Tuning coil	L12	1
L34-2081-05	N	Tuning coil	L15	1
L34-2082-05	N	Tuning coil	L16	1
L34-2083-05	N	Tuning coil	L18	1
L34-2085-05	N	Tuning coil	L22	1
L34-2086-05	N	Tuning coil	L23	1
L34-2087-05	N	Tuning coil	L24	1
L34-2088-05	N	Tuning coil	L25	1
L34-2089-05	N	Tuning coil	L26	1
L34-2090-05	N	Tuning coil	L27	1
L34-2091-05	N	Tuning coil	L29	1
L34-2092-05	N	Tuning coil	L30	1
L34-2093-05	N	Tuning coil	L31,32	2
L34-2094-05	N	Tuning coil	L33	1
L34-2095-15	N	Tuning coil	L34	1
L34-2096-05	N	Tuning coil	L35	1
L34-2097-05	N	Tuning coil	L17	1
L34-2098-05	N	Tuning coil	L19	1
L34-2099-05	N	Tuning coil	L38,39	2
L34-2100-25	N	Tuning coil	L40	1
L34-2101-05	N	Tuning coil	L41	1
L34-2102-25	N	Tuning coil	L42	1
L34-2103-15	N	Tuning coil	L43	1
L34-2104-05	N	Tuning coil	L44	1
L34-2105-15	N	Tuning coil	L45	1
L34-2106-05	N	Tuning coil	L66,68	2
L34-2107-15	N	Tuning coil	L67	1

PARTS LIST

Parts No.	Re marks	Description	Ref. No.	Q'ty
L34-2108-15	N	Tuning coil	L77	1
L34-2109-15	N	Tuning coil	L84	1
L34-2111-05	N	Tuning coil	L88,92	2
L34-2112-05	N	Tuning coil	L89,91	2
L34-2113-05	N	Tuning coil	L90	1
L34-2114-15	N	Tuning coil 44.93MHz	L94	1
L34-2115-15	N	Tuning coil 44.93MHz	L95	1
L34-2116-15	N	Tuning coil 44.93MHz	L96,97	2
L34-2117-15	N	Tuning coil	L98	1
L34-2118-15	N	Tuning coil 8.83MHz	L112	1
L34-2121-05	N	Tuning coil 455kHz	L131	1
L34-2122-05	N	Tuning coil 455kHz	L134	1
L34-2123-15	N	Tuning coil	L132,142	2
L34-2124-05	N	Tuning coil 455kHz	L165	1
L34-2125-15	N	Tuning coil 355kHz	L146–148	3
L34-2127-15	N	Tuning coil	L167	1
L34-2128-15	N	Tuning coil	L168	1
L34-2129-05	N	Tuning coil	L175	1
L40-1011-03		Ferri-inductor 100μH	L83	1
L40-1011-04		Ferri-inductor 100μH	L82,87,101	3
L40-1021-03		Ferri-inductor 1mH	L3,149–151	4
L40-1511-03		Ferri-inductor 150μH	L2,118,119	3
L40-1541-27		Ferri-inductor 150mH	L170,171	2
L40-1811-03		Ferri-inductor 180μH	L86	1
L40-2201-03		Ferri-inductor 22μH	L55,56	2
L40-2291-02		Ferri-inductor 2.2μH	L36	1
L40-2701-03		Ferri-inductor 27μH	L57,58	2
L40-3301-03		Ferri-inductor 33μH	L59,60	2
L40-3391-03		Ferri-inductor 3.3μH	L174	1
L40-4701-03		Ferri-inductor 47μH	L65,69–73,76, 78,79	9
L40-4701-11		Ferri-inductor 47μH	L120	1
L40-4711-03		Ferri-inductor 470μH	L1,4,46–50, 61–64,74,75,110, 114,116,117,138, 141,154–159, 162–164,176	29
L40-4725-04		Ferri-inductor 4.7mH	L14	1
L40-4791-02		Ferri-inductor 4.7μH	L10,37	2
L40-5691-02		Ferri-inductor 5.6μH	L85	1
L40-8291-02		Ferri-inductor 8.2μH	L28	1
L71-0234-05	N	MCF 44.93MHz	XF1,2	1A
L71-0235-05	N	MCF 8.830MHz	XF3	1
L72-0319-05		Ceramic filter 455kHz	CF2	1
L72-0334-05	N	Ceramic filter 455kHz	CF1	1
L77-0965-15	N	Crystal 36.1MHz	X1	1
L77-0966-05	N	Crystal 8375kHz	X2	1
L77-0967-05	N	Crystal 8828.5kHz	X4	1
L77-0968-05	N	Crystal 8830kHz	X5	1
L77-0969-05	N	Crystal 8831.5kHz	X3	1
N10-2030-41		Nut		6
N30-3008-41		Round screw		4
N30-3010-41		Round screw		8
N87-3006-41		Self tapping screw		3
R12-0401-05		Trim. pot. 100Ω	VR21	1
R12-0420-05		Trim. pot. 500Ω	VR2,6	2
R12-0430-05	N	Trim. pot. 470Ω	VR3	1
R12-0531-05		Trim. pot. 500Ω	VR18	1
R12-1405-05		Trim. pot. 1kΩ	VR33	1
R12-1424-05	N	Trim. pot. 4.7kΩ	VR23,24,27	3

Parts No.	Re marks	Description	Ref. No.	Q'ty
R12-2409-05		Trim. pot. 5kΩ	VR1	1
R12-3411-05		Trim. pot. 47kΩ	VR8–10,15,16 26,28,32,34	9
R12-3413-05		Trim. pot. 10kΩ	VR11,13,25,30	4
R12-3438-05	N	Trim. pot. 22kΩ	VR7,29	2
R12-5414-05	N	Trim. pot. 100kΩ	VR12,17,31	3
R12-5415-05	N	Trim. pot. 150kΩ	VR20	1
R12-6404-05		Trim. pot. 470kΩ	VR14,19	2
RN14BK2E103F		MF 10kΩ 1/4W	R272,275,277	3
RN14BK2E271F		MF 270Ω 1/4W	R519,520	2
RN14BK2E912F		MF 9.1kΩ 1/4W	R273	1
RN14BK2E1503F		MF 150kΩ 1/4W	R276	1
RS14AB3A331J		MF 330Ω 1W	R20	1
R90-0163-05	N	Inline block 47kΩx9	IB1	1
R90-0549-05	N	Inline block 0.022x8	IB4	1
R90-0551-05	N	Inline block 0.01x4	IB2,3	2
R90-0553-05	N	Inline block	IB5	1
R92-0150-05		Short jumper		142
S51-1404-05		Relay	RL1–3	3

AT UNIT (X57-1010-00)

Parts No.	Re marks	Description	Ref. No.	Q'ty
C02-0022-05	N	Variable cap.	VC1,2	2
C05-0315-05		Ceramic trimmer 60pF	TC1	1
CE04W0J101M		E 100 6.3V	C19,21	2
CE04W1C100M		E 10 16V	C47	1
CE04W1E220M		E 22 25V	C31	1
CE04W1E470M		E 47 25V	C18,20	2
CE04W1H101M		E 100 50V	C32	1
CC45SL2H121J		C 120pF 500V	C29	1
CC45SL2H151J		C 150pF 500V	C30	1
CK45B1H102K		C 0.001	C25,26,37–40, 44,45	8

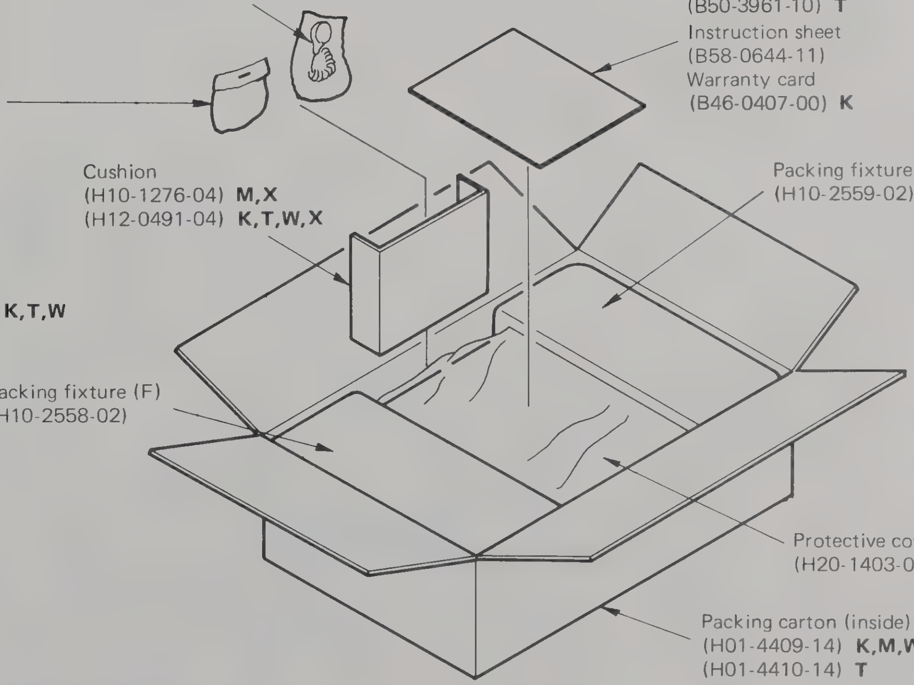
PARTS LIST/PACKING

Parts No.	Re marks	Description	Ref. No.	Q'ty
CK45F1H103Z		C 0.01	C1–6,8–17 33–36,46	22
CQ92M1H333K		ML 0.033	C43	1
C91-0456-05		C 0.047	C22,23,27,28,42	5
D22-0408-05	N	Coupling		2
D40-0623-25	N	Gear ass'y		1
D40-0624-25	N	Gear ass'y		1
E04-0154-05		Coax. connector		6
E40-0473-05		Mini connector 4P		2
E40-0673-05		Mini connector 6P		2
E40-0873-05		Mini connector 8P		1
J31-0502-04		PC board collar		6
J42-0428-05		PC board bushing		6
L34-2133-15	N	Tuning coil A	L20	1
L34-2134-05	N	Tuning coil B	L19	1
L39-0415-15	N	Detector coil A	L18	1
L39-0416-05	N	Detector coil B	L17	1
L40-1011-04		Ferri-inductor 100μH	L13,14,21	3
L40-1011-12		Ferri-inductor 100μH	L8–11	4
L40-1511-03		Ferri-inductor 150μH	L12,22–25	5
L40-4711-03		Ferri-inductor 470μH	L1–6,15	7
L40-4711-12		Ferri-inductor 470μH	L7,16	2
L92-0103-05		Toroid core		2
L92-0115-05	N	Toroid core		1
N09-0256-05		Gnd. screw		1
N10-2030-46		Nut		1

Parts No.	Re marks	Description	Ref. No.	Q'ty
N30-3006-46		Round screw		1
N35-3006-41		Bind screw		4
N87-3006-41		Self tapping screw		7
N87-3012-41		Self tapping screw		6
N88-3008-41		Flat tapping screw		10
R12-2401-05		Trim. pot. 5kΩ	VR1	1
R12-3401-05		Trim. pot. 10kΩ	VR2	1
RC05GF2H101J		Solid 100Ω 1/2W	R112,113	2
RC05GF2H151J		Solid 150Ω 1/2W	R150	1
RC05GF2H270J		Solid 27Ω 1/2W	R46,49,62,65	4
RN14BK2E103F		MF 10kΩ 1/4W	R96,97,100,101	4
RS14AB3A102J		MF 1kΩ 1W	R129,131	2
RS14AB3A271J		MF 270Ω 1W	R75	1
RS14AB3A330J		MF 33Ω 1W	R132	1
RS14AB3A390J		MF 39Ω 1W	R92	1
RS14AB3D271J		MF 270Ω 2W	R76	1
R90-0554-05		Inline block	IB1	1
R90-0555-05	N	Inline block	IB2	1
	N			
R92-0150-05		Short jumper		37
S51-1412-05		Relay	RL2–6	5
S51-2408-05		Relay	RL9	1
S51-2411-05	N	Relay	RL1,8	2
T42-0303-05	N	Motor		2

PACKING

- Protective bag (H25-0105-04)
  - AC cord ass'y (E30-1643-15) **K,M**
  - AC cord ass'y (E30-1644-15) **T**
  - AC cord ass'y (E30-1645-05) **W**
  - AC cord ass'y (E30-1647-05) **X**
  - Protective bag (H25-0120-04)
    - 7P DIN plug (E07-0751-05)
    - Phone plug (E12-0001-15)
    - Fuse 4A (F05-4022-05) **M,T,W,X**
    - Fuse 6A (F05-6021-05) **K,M**
    - Protective bag **K,T,W**
      - 8P metal socket (E07-0852-05) **K,T,W**



Microphone
(T91-0316-15) **M,X**

Instruction manual
(B50-3959-20) **K,M,W,X**
(B50-3961-10) **T**
Instruction sheet
(B58-0644-11)
Warranty card
(B46-0407-00) **K**

Cushion
(H10-1276-04) **M,X**
(H12-0491-04) **K,T,W,X**

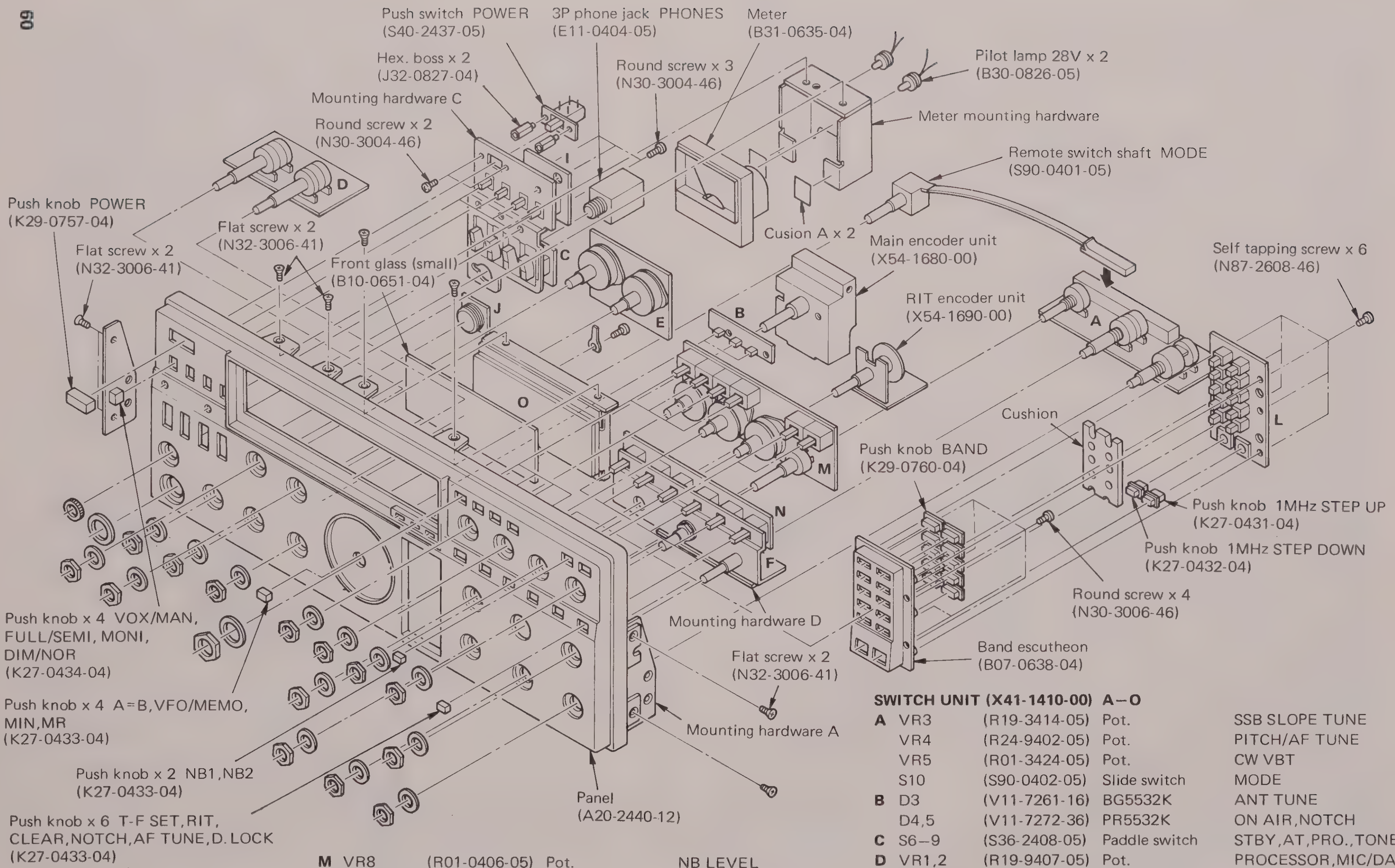
Packing fixture (R)
(H10-2559-02)

Packing fixture (F)
(H10-2558-02)

Protective cover
(H20-1403-03)

Packing carton (inside)
(H01-4409-14) **K,M,W,X**
(H01-4410-14) **T**

DISASSEMBLY

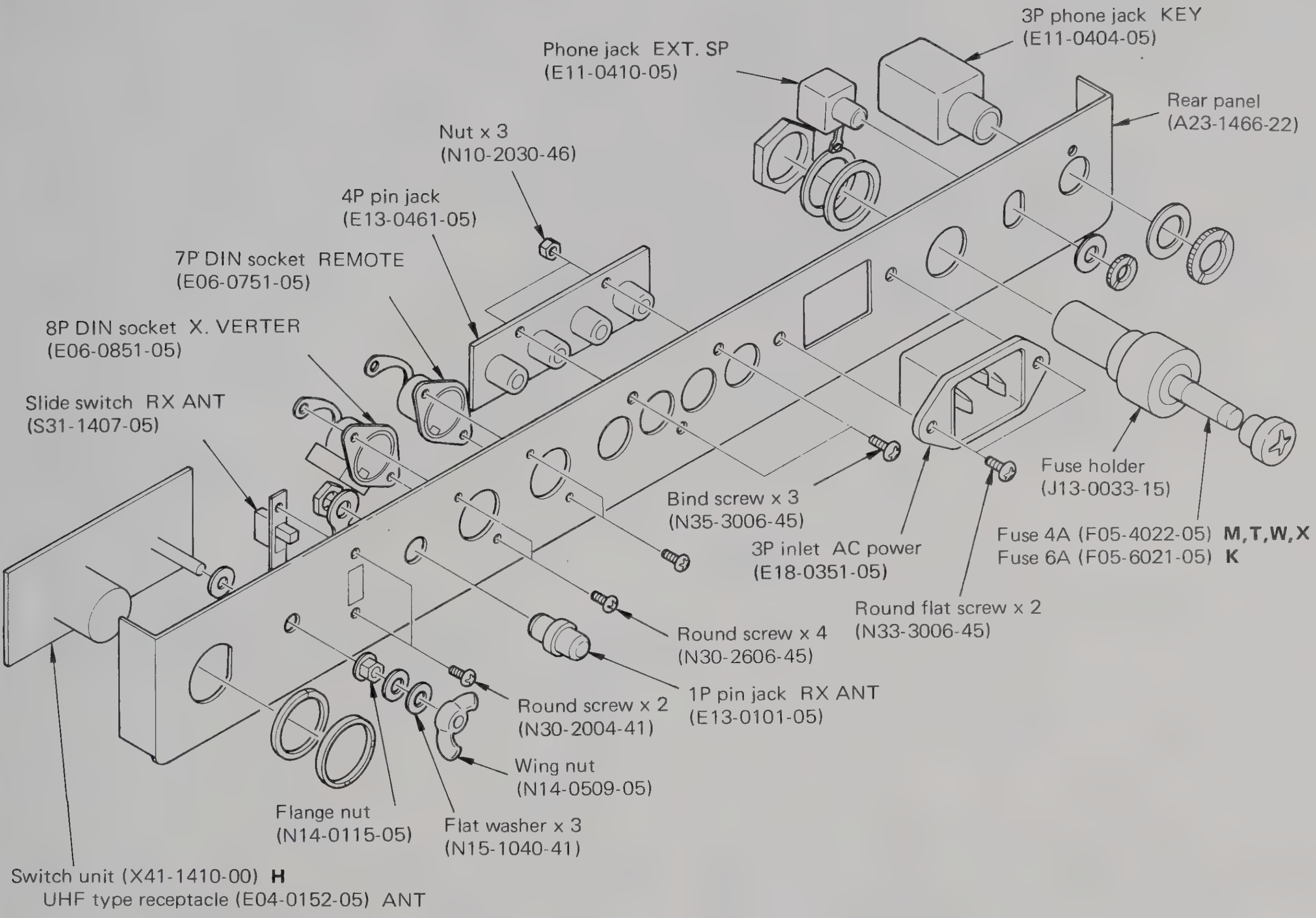

Push switch POWER (S40-2437-05)
3P phone jack PHONES (E11-0404-05)
Meter (B31-0635-04)
Hex. boss x 2 (J32-0827-04)
Round screw x 3 (N30-3004-46)
Pilot lamp 28V x 2 (B30-0826-05)
Mounting hardware C
Meter mounting hardware
Round screw x 2 (N30-3004-46)
Remote switch shaft MODE (S90-0401-05)
I
D
Push knob POWER (K29-0757-04)
Flat screw x 2 (N32-3006-41)
Cusion A x 2
Main encoder unit (X54-1680-00)
Self tapping screw x 6 (N87-2608-46)
Flat screw x 2 (N32-3006-41)
Front glass (small) (B10-0651-04)
C
RIT encoder unit (X54-1690-00)
J
B
E
A
O
Cushion
L
Push knob BAND (K29-0760-04)
M
Push knob 1MHz STEP UP (K27-0431-04)
N
Push knob 1MHz STEP DOWN (K27-0432-04)
F
Round screw x 4 (N30-3006-46)
Push knob x 4 VOX/MAN, FULL/SEMI, MONI, DIM/NOR (K27-0434-04)
Mounting hardware D
Band escutheon (B07-0638-04)
Flat screw x 2 (N32-3006-41)
Push knob x 4 A=B, VFO/MEMO, MIN, MR (K27-0433-04)
Mounting hardware A
Push knob x 2 NB1, NB2 (K27-0433-04)
Panel (A20-2440-12)
Push knob x 6 T-F SET, RIT, CLEAR, NOTCH, AF TUNE, D. LOCK (K27-0433-04)

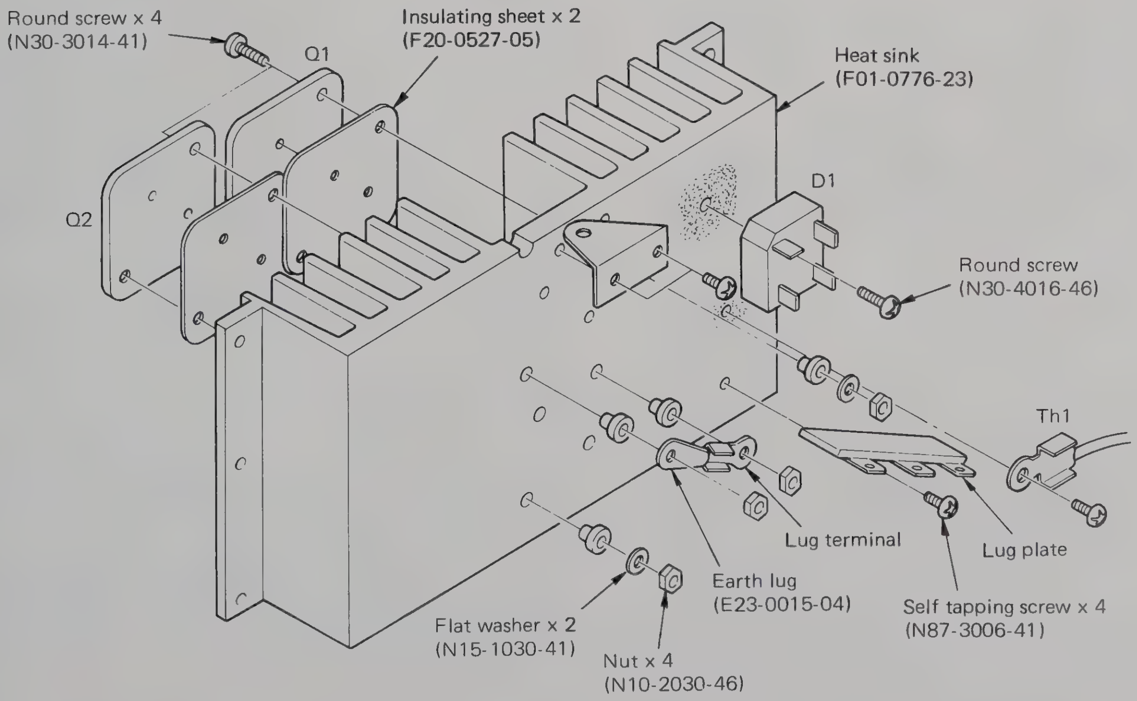
SWITCH UNIT (X41-1410-00) A–O

A	VR3	(R19-3414-05)	Pot.	SSB SLOPE TUNE
	VR4	(R24-9402-05)	Pot.	PITCH/AF TUNE
	VR5	(R01-3424-05)	Pot.	CW VBT
	S10	(S90-0402-05)	Slide switch	MODE
B	D3	(V11-7261-16)	BG5532K	ANT TUNE
	D4,5	(V11-7272-36)	PR5532K	ON AIR,NOTCH
C	S6–9	(S36-2408-05)	Paddle switch	STBY,AT,PRO.,TONE
D	VR1,2	(R19-9407-05)	Pot.	PROCESSOR,MIC/DAR
E	S39	(S01-1430-05)	Rotary switch	METER
	S40	(S01-1431-05)	Rotary switch	AGC
F	VR6	(R01-3423-05)	Pot.	NOTCH
	VR7	(R19-3413-05)	Pot.	AF/RF
I	S2,5	(S40-2433-05)	Push switch	VOX/MAN,DIM/NOR
	S3,4	(S40-2434-05)	Push switch	FULL/SEMI,MONI
J	–	(E06-0853-05)	8P metal socket	MIC
L	S26,27	(S50-1409-05)	Tact switch	1MHz STEP
	S28–37	(S50-1411-05)	Tact switch	BAND

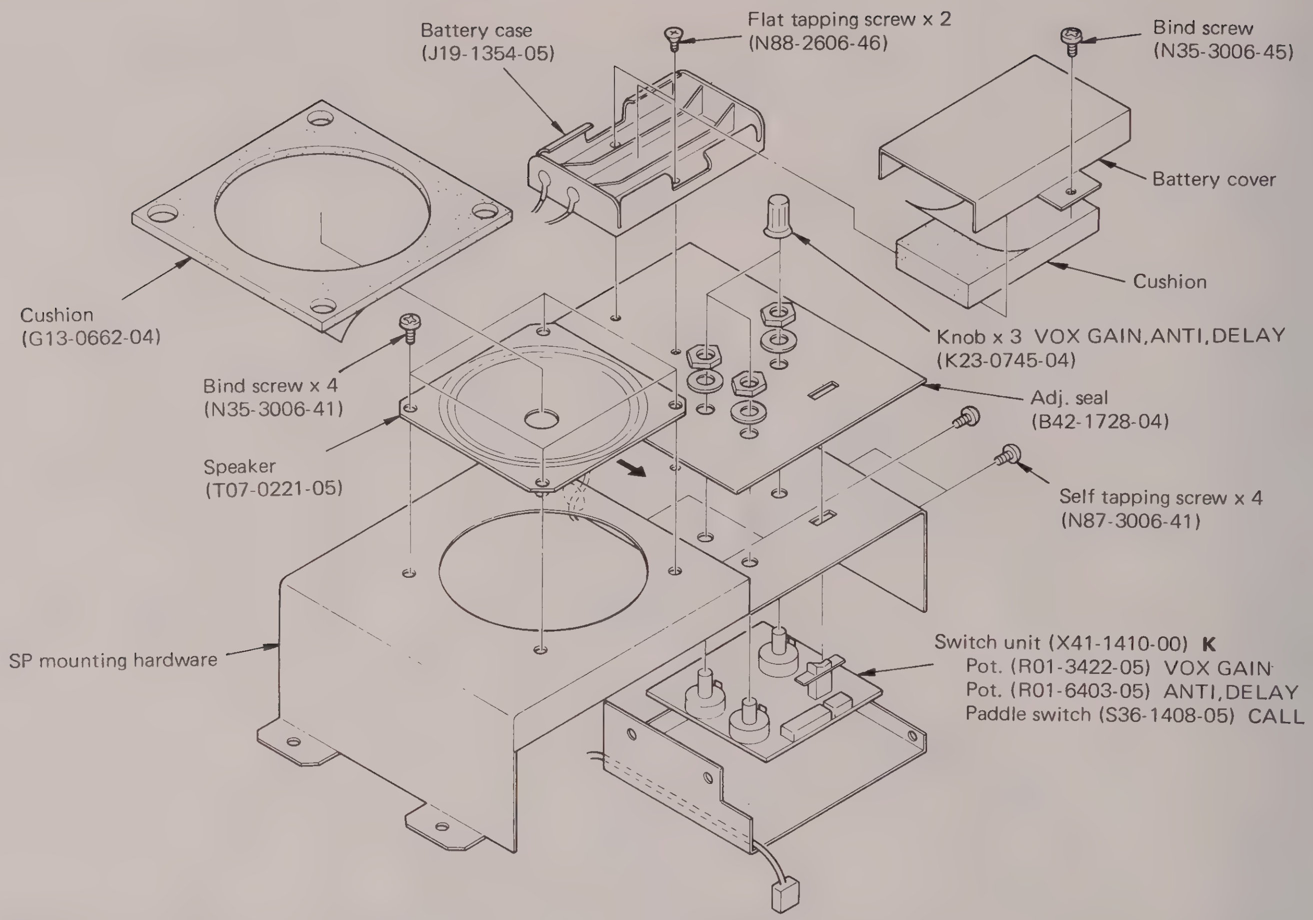
M	VR8	(R01-0406-05)	Pot.	NB LEVEL
	S17,19,20	(S40-2435-05)	Push switch	A=B,M$_{\text{IN}}$,MR
	S18,21,22	(S40-2434-05)	Push switch	VFO/MEMO,NB1,NB2
	S23,25	(S01-1432-05)	Rotary switch	FUNCTION,RF ATT
	S24	(S01-1429-05)	Rotary switch	M. CH
N	S11,13	(S40-2432-05)	Push switch	T-F SET,RIT-CL
	S12	(S40-2431-05)	Push switch	RIT
	S14,16	(S40-2422-05)	Push switch	NOTCH,D. LOCK
	S15	(S40-2433-05)	Push switch	AF TUNE
O	V1	(V40-7760-66)	11-BT-03Z	Display tube

DISASSEMBLY


3P phone jack KEY
(E11-0404-05)
Phone jack EXT. SP
(E11-0410-05)
Rear panel
(A23-1466-22)
Nut x 3
(N10-2030-46)
4P pin jack
(E13-0461-05)
7P DIN socket REMOTE
(E06-0751-05)
8P DIN socket X. VERTER
(E06-0851-05)
Slide switch RX ANT
(S31-1407-05)
Fuse holder
(J13-0033-15)
Bind screw x 3
(N35-3006-45)
Fuse 4A (F05-4022-05) **M,T,W,X**
Fuse 6A (F05-6021-05) **K**
3P inlet AC power
(E18-0351-05)
Round flat screw x 2
(N33-3006-45)
Round screw x 4
(N30-2606-45)
1P pin jack RX ANT
(E13-0101-05)
Round screw x 2
(N30-2004-41)
Wing nut
(N14-0509-05)
Flange nut
(N14-0115-05)
Flat washer x 3
(N15-1040-41)
Switch unit (X41-1410-00) **H**
UHF type receptacle (E04-0152-05) ANT


Round screw x 4
(N30-3014-41)
Q1
Insulating sheet x 2
(F20-0527-05)
Heat sink
(F01-0776-23)
Q2
D1
Round screw
(N30-4016-46)
Th1
Lug terminal
Lug plate
Earth lug
(E23-0015-04)
Self tapping screw x 4
(N87-3006-41)
Flat washer x 2
(N15-1030-41)
Nut x 4
(N10-2030-46)

DISASSEMBLY


Battery case
(J19-1354-05)
Flat tapping screw x 2
(N88-2606-46)
Bind screw
(N35-3006-45)
Battery cover
Cushion
Cushion
(G13-0662-04)
Bind screw x 4
(N35-3006-41)
Knob x 3 VOX GAIN, ANTI, DELAY
(K23-0745-04)
Adj. seal
(B42-1728-04)
Speaker
(T07-0221-05)
Self tapping screw x 4
(N87-3006-41)
SP mounting hardware
Switch unit (X41-1410-00) K
Pot. (R01-3422-05) VOX GAIN
Pot. (R01-6403-05) ANTI, DELAY
Paddle switch (S36-1408-05) CALL

● Disassembly and cautions for rear panel

(1) Take care not to damage terminals ANT and GND on the rear panel since they are soldered or screwed to the PC board.

(2) When repairing the final section, remove the upper and lower cases, then the final heatsink and shield case for the Filter unit. (When repairing the Filter unit, remove the above parts, too.)

● Disassembly and cautions for internal mechanism

(1) Cautions on replacement of transformer
Tighten the hexagon socket head bolts to a torque of 20kg-cm. Check the transformer for shock, looseness, and correspondence.

(2) When repairing the Signal unit under the chassis, take much care.
  1) To remove the PC board from the chassis, remove 19 screws.
  2) The weight of PC board and radiator plate is about 1kg in total.
However, the optional filter can be installed easily without removing the Signal PC board.

(3) Removing mounting hardware for the electrolytic capacitor
The mounting hardware for electric capacitor can be removed by removing two screws from one side of the mounting hardware and sliding it toward the screws (to left side when viewed from the front panel).

(4) The speaker is installed to the mounting hardware on the chassis, different from the models in the past.

● Disassembly for front panel

(1) The front panel may be tilted for servicing by removing the 2 flat head screws at the top sides of the panel, and loosening the 2 round head screws at the bottom. Use caution as the panel is heavy and may fall forward.

(2) When replacing the name plate on the display window for display tube and meter, 1st remove the meter. Push the name plate from rear with a thin screw driver through the square hole on the panel. When replacing the front glass, remove the name plate and two flat screws (M2 x 6). (The front glass grille can be removed at the same time.)

(3) When removing the display tube from the mounting bracket, insert a thin screw driver, etc. into the bracket at both sides. Remove the display tube with the screw driver form the projection of the mounting hardware for display tube.

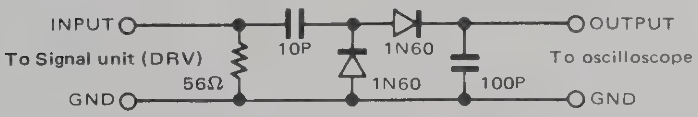
(4) Removing main knob
Slip the outside rubber ring from the knob. The allen set screw can now be loosened and the knob removed.

(5) Removing band switch assembly
Remove the six screws securing the PC board. Then, remove push knobs ($\boxed{1.5}$ $\boxed{3.5}$ ......), cushions, and the four round screws which secure the escutcheon to the front panel.

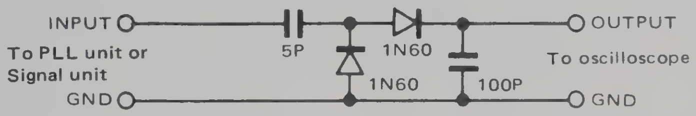
ADJUSTMENT

REQUIRED TEST EQUIPMENT

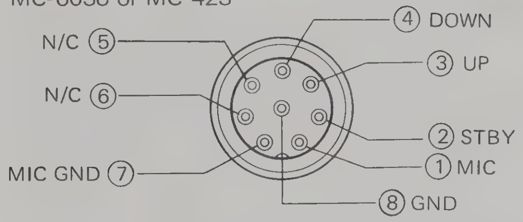
1. DC Voltmeter (DC V.M)
   1) Input resistance : More than 1MΩ
   2) Voltage range : 1.5 to 1000V AC/DC
   NOTE : A high-precision multimeter may be used. However, accurate readings can not be obtained for high-impedance circuits.
2. DC Ammeter
   1) Current range : 100mA, 1.5A, 15A, High-precision ammeter may be used.
3. RF VTVM (RF V.M)
   1) Input impedance : 1MΩ and less than 3pF, min.
   2) Voltage range : 10mV to 300V
   3) Frequency range : 10kHz to 100MHz or greater
4. AF Voltmeter (AF V.M)
   1) Frequency range : 50Hz to 10kHz
   2) Input resistance : 1MΩ or greater
   3) Voltage range : 10mV to 30V
5. AF Generator (AG)
   1) Frequency range : 200Hz to 5kHz
   2) Output : 1mV or less to 1V, low distortion
6. AF Dummy Load
   1) Impedance : 8Ω
   2) Dissipation : 3W or greater
7. Oscilloscope (Dual trace)
   Requires high sensitivity, and external synchronization capability.
8. Sweep Generator
   1) Center frequency : 50kHz to 90MHz
   2) Frequency deviation : Maximum±35MHz
   3) Output voltage : 0.1V or greater
   4) Sweep rate : At least 0.5sec/cm
9. Standard Signal Generator (SSG)
   1) Frequency range : 50kHz to 50MHz
   2) Output : –20dB/0.1μV to 120dB/1V
   3) Output impedance : 50Ω
   4) AM and FM modulation can be possible.
   NOTE : Generator must be frequency stable.
10. Frequency Counter (f. counter)
    1) Minimum input voltage : 50mV
    2) Frequency range : 50MHz or greater
    3)
11. Noise Generator
    Must generate ignition-like noise containing harmonics beyond 30MHz.
12. RF Dummy Load
    1) Impedance : 150Ω
    2) Dissipation : 150W or greater
13. Power Meter
    1) Impedance : 50Ω
    2) Dissipation : 150W continuous or greater
    3) Frequency limit : 60MHz or greater
14. Spectrum Analyzer
    1) Frequency range : 100kHz to 110MHz or greater
    2) Bandwidth : 1kHz to 3MHz
15. Detector
    1) For adjustment of TX BPF



    2) For adjustment of PLL/VCO BPF



16. Directional Coupler
17. Monitor Receiver
    R-1000 class
18. Microphone
    MC-60S8 or MC-42S



MIC terminals (View from front panel side)

PREPARATION

Unless otherwise specified, set the controls as follows.

Front panel

POWER. . . . . .ON
BAND. 14
AF . . . . .MIN
RF . . . . .MAX
MIC . . . . .MIN
PROCESSOR IN. . .MIN
PROCESSOR OUT .MIN
CAR . . . . .MIN
FUNCTION . . . . . .A
CW VBT . . . . .NORM.
SSB SLOPE
TUNE LOW . . . . . .MIN
SSB SLOPE
TUNE HIGH . . . . .MAX
PITCH. . . . . .CEN
AF TONE . . . . . . .CEN
NOTCH. . . . . .CEN
MEMORY CH. 1
METER SW . . . . . .POWER

RIT SW. . . . . .OFF
NB1 . . . . .OFF
NB2 . . . . .OFF
D. LOCK. . . . . . . .OFF
AF TUNE . . . . . . .OFF
VFO/MEMO. . . . . .VFO
MONI . . . . .OFF
DIM/NOR . . . . . . .NOR
SEND/REC . . . . . .REC
FULL/SEMI . . . . . .SEMI
MODE. . . . . .USB
NOTCH SW . . . . . .OFF
VOX/MAN. . . . . . .MAN
AUTO/THRU. . . . .THRU
PROCESSOR SW . .OFF
NAR/ WIDE. . . . . .WIDE
AGC SW . . . . .FAST
RF ATT 0
NB LEVEL . . . . . .MIN

Rear panel

RX ANT . . . . .OFF

ADJUSTMENT

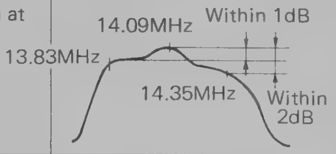
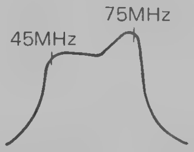
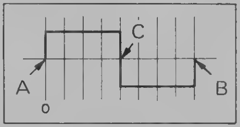
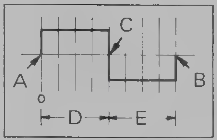
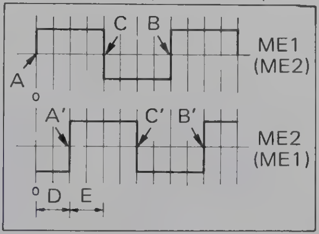
VOLTAGE ADJUSTMENT

Item	Condition	Measurement			Adjustment			Specification/Remarks
		Test equipment	Unit	Terminal	Unit	Part	Method	
1.Voltage	1) POWER : ON	DC V.M	AVR	28B	AVR	VR1	28.5V	± 0.3V
	RF GAIN : MAX (Full CW)		SIG-NAL	Connector 28-RV	SIG-NAL	VR24	16.0V	± 0.1V
	MODE : USB			R375 (AGC)		VR29	3.20V	± 0.01V
	STBY : REC			Jumper wire J13		VR25	2.20V	± 0.01V
2.TX Control voltage	1) STBY : REC	DC V.M	SIG-NAL	Connector 5-TV			Check	Less than –0.8V
	2) STBY : SEND						Check	16.0V ± 0.3V
	3) STBY : SEND			Jumper wire J89	SIG-NAL	VR13	3.20V	± 0.01V
3. SWR standard voltage	1) STBY : REC	DC V.M	SIG-NAL	IC4-12	SIG-NAL	VR15	0.5V	± 0.01V This is a reference level for the SWR circuitry. It will effect the auto antenna tuner.

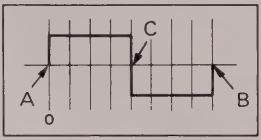
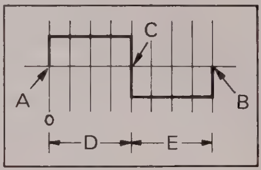
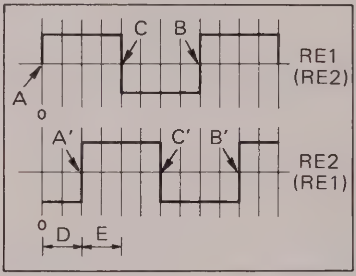
PLL ADJUSTMENT

Item	Condition	Measurement			Adjustment			Specification/Remarks
		Test equipment	Unit	Terminal	Unit	Part	Method	
1. Standard Oscillator		f. counter	PLL	IC16-1	PLL	TC1	10,000,000Hz	± 5Hz
2. 40MHz multiplier		RF V.M	PLL	IC14-5	PLL	T16–18	MAX	
3. VCO-3	1)	f. counter	PLL	IC13–15	PLL	TC2	10,240,000Hz	± 10Hz
	2) FREQ : □□,□□1.9$\boxed{9}$kHz To obtain this frequency 1st set dial to □2.0$\boxed{0}$. Then using mic pushbutton depress button (DWN) one step at a time until the display just changes to □1.9$\boxed{9}$ frequency changes in 10Hz steps are obtained in this manner.	DC V.M		Q32-C		T14	4.2V	± 0.05V □ DENOTES STEP 9 (90Hz) or one step before the next 100Hz (.xxx.1) Transition
	3) FREQ : □□,□□0.0$\boxed{0}$kHz Use similar method in step 3. 2) PLL adjustment						Check	9.5V ± 0.5V
4. VCO-2	1) FREQ : □□,999.9$\boxed{9}$kHz Use similar method in step 3. 2) PLL adjustment.	DC V.M	PLL	Q24-C	PLL	T15	3.5V	± 0.05V
	2) FREQ : □□,000.0$\boxed{0}$kHz For 10Hz level, tune VFO one step before □□,999.□□						Check	8.5V ± 0.5V
5. VCO-1L (Low)	1) FREQ : 100.0kHz Tune VFO fully CCW	DC V.M	SIG-NAL	R81	SIG-NAL	L54	13.50V	± 0.1V
	2) FREQ : 9,499.9$\boxed{9}$kHz						Check	6.0V ± 1.0V
6. VCO-1M (Medium)	1) FREQ : 9,500.0$\boxed{0}$kHz For 10Hz level, tune VFO to one step before 9,499.9$\boxed{9}$	DC V.M	SIG-NAL	R81	SIG-NAL	L53	3.00V	± 0.1V
	2) FREQ : 19,499.9$\boxed{9}$kHz						Check	12.0V ± 1.0V
7. VCO-1H (High)	1) FREQ : 29,999.9$\boxed{9}$kHz Tune VFO fully CW to 29,999.99$\boxed{9}$ kHz.	DC V.M	SIG-NAL	R81	SIG-NAL	L52	13.00V	± 0.1V
	2) FREQ : 19,500.0$\boxed{0}$kHz						Check	3.0V + 1.0V, –0.5V

ADJUSTMENT

Item	Condition	Measurement			Adjustment			Specification/Remarks
		Test equipment	Unit	Terminal	Unit	Part	Method	
8. PLL-BPF	1) Disconnect connector 8, CAR 1. Reconnect after adjustment.	Sweep generator Detector Oscilloscope	PLL	IC6-2 Q17-E	PLL	T7–9	Adjust as shown at right.	
9. PLL 8.85MHz IF	1)	RF V.M	PLL	IC6-5 or IC7-2	PLL	T13	MAX	(Ref. 100mV–120mV)
	2)					VR1	100mV	± 5mV
10. PLL 5.2MHz IF	1)	RF V.M	PLL	Q17-E	PLL	T10	MAX	
	2)			IC6-2		VR2	100mV	± 5mV
11. PLL 50.15MHz IF	1)	RF V.M	PLL	Q18-E	PLL	TC3	110mV	± 5mV
	2)			Q16-E		T4–6	MAX	(Ref. 100mV)
12. PLL 60.15MHz IF	1)	RF V.M	PLL	IC3-5	PLL	T1–3	MAX	
	2)					T11,12	MAX	
	3)			Q17-E			Check If above 150mV, lower to below 150 mV with VR1. (Must remove VCO shield).	100–150mV
13. VCO-BPF		Sweep generator Detector Oscilloscope	SIGNAL	Q16-G Q20-E	SIGNAL	L66–68	Adjust as shown at right.	
14. 36.1MHz HET	1)	RF V.M	SIGNAL	R125	SIGNAL	L77	0.21V (Adjust CW from MAX in direction [core is inserted].)	0.5dB
	2)	f.counter					Check	36.100MHz ± 1kHz
15. VCO level	1) FREQ : 15,250.0kHz	RF V.M	PLL	Q14-E	PLL	TC4	160mV	± 10%
16. Main encoder	1) Remove the VFO knob and motor-drive the encoder at approx 300 rpm.	Oscilloscope	Digital	Connector 4-ME1				Point C may be located anywhere. When a motor is not available, manually turn the VFO to check the duty ratio. (AC=CB)
	2) ME1 duty ratio adjustment : Turn motor CW and CCW				Main encoder	VR1		After adjusting with the VFO control turned CW, check that intervals D and E are also identical when the VFO control is turned CCW.
	3) ME2 duty ratio adjustment : (Check as for ME1)			Connector 4-ME2		VR2	Adjust until intervals D and E are equal to each other with point C placed at the center.	
	4) ME1, ME2 phase difference alignement  C B ME1 (ME2) A o A' C' B' ME2 (ME1) o D E			Connector 4-ME1 and ME2		Phase adjustment screw	Adjust until intervals D and E are equal to each other (point A' on ME2 is located in the middle of points A and C on ME1 90° phase shift)	ME1 (ME2) : Within 90° ± 10% (The difference between CW and CCW rotation must also be within this specification.) Either ME1 or ME2 may lead, the important point is phase difference.

ADJUSTMENT

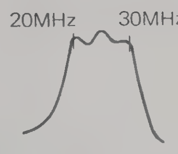
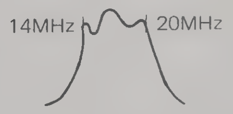
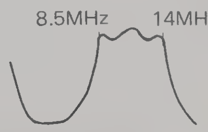
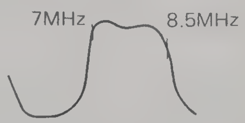
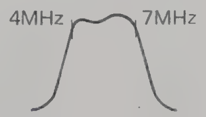
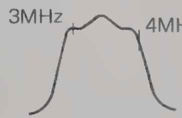
Item	Condition	Measurement			Adjustment			Specification/Remarks
		Test equipment	Unit	Terminal	Unit	Part	Method	
17. RIT encoder	1) Remove the RIT knob and motor-drive the encoder at approx 300 rpm.	Oscilloscope	Digital	Connector 5-RE1				Point C may be located anywhere. When a motor is not available, manually turn the RIT to check the duty ratio. (AC=CB)
	2) RE1 duty ratio adjustment : Turn a CW and CCW				RIT encoder	VR1		After adjusting with the RIT control turned CW, check that intervals D and E are also identical when the RIT control is turned CCW.
	3) RE2 duty ratio adjustment : Turn motor in both directions.			Connector 5-RE2		VR2	Adjust until intervals D and E are equal to each other with point C placed at the center.	
	4) RE1, RE2 phase difference alignment : Same as above.			Connector 5-RE1 and RE2			 C B RE1 (RE2) A o A' C' B' RE2 (RE1) o D E	Either RE1 or RE2 may lead, the important point is the phase difference. It should be 90° ±10% .

○ : From S/N 208XXXX–309XXXX
● : From S/N 310XXXX–

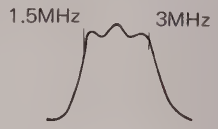
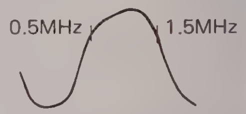
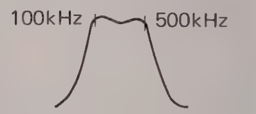
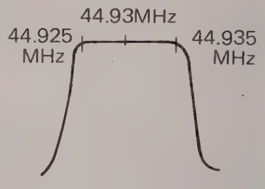
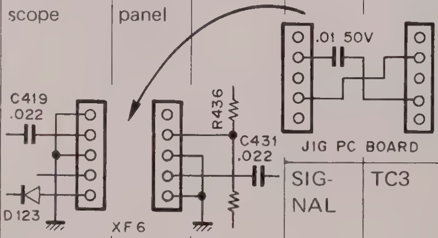
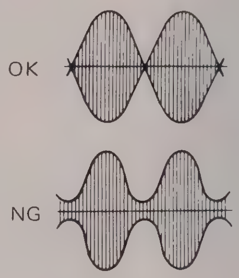
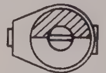
RX ADJUSTMENT

Item	Condition	Measurement			Adjustment			Specification/Remarks
		Test equipment	Unit	Terminal	Unit	Part	Method	
1. CAR-1	1) MODE : USB STBY : REC	RF V.M	SIGNAL	Connector 24-CAR1	SIGNAL	L161	0.21V : ○, 0.1V : ● (Adjust CCW from MAX)	± 1dB
	2) STBY : REC ↔ SEND	f.counter				VR27	No change in frequency when switched from TX to RX.	
	3) STBY : REC					TC4	8831.5kHz	These are preliminary adjutments. Do not forget to perform the transmitter frequency response portion steps 15, 1) through 6).
	4) MODE : LSB STBY : REC					TC5	8828.5kHz	
	5) MODE : FSK STBY : SEND					VR26	8827.79kHz	
	6) MODE : CW NAR/WIDE : NARROW STBY : SEND					TC6	8830.000kHz	± 10Hz

ADJUSTMENT

Item	Condition	Measurement			Adjustment			Specification/Remarks
		Test equipment	Unit	Terminal	Unit	Part	Method	
2. CAR-2 If TC3 is adjusted, Step 8 adjustments must be performed.	1) MODE : USB STBY : REC	RF V.M	SIG-NAL	Q79-E (R472)	SIG-NAL	L142–145	MAX	
						L139	0.35V (Adjust CCW from MAX)	± 1dB
	2) MODE : USB ↔ LSB STBY : REC					L144, 145	Same level, When switched from USB to LSB.	± 0.5dB
	3) MODE : USB STBY : REC ↔ SEND	f. counter		C298		VR23	No change in frequency, when switched from TX to RX.	
	4) MODE : USB STBY : REC					TC3	8.375MHz	
3. CAR-3	1) MODE : CW STBY : REC	f. counter	SIG-NAL	Q141-E	SIG-NAL	L169	100,000Hz (100kHz)	± 20Hz
	2) MODE : USB						Verify	101.5kHz ± 200Hz
	3) MODE : LSB							98.5kHz ± 200Hz
	4) MODE : AM							100.0kHz ± 100Hz
	5) MODE : FSK							98.5kHz ± 200Hz
	6) MODE : TUNE							100.0kHz ± 20Hz
4. CW PITCH Rotate RF gain full CCW this step only.	1) MODE : CW CW PITCH : 12 o'clock STBY : REC	RF V.M	SIG-NAL	R836	SIG-NAL	L172	MAX	0.27–0.47V (reference)
		f. counter				L173	99,200Hz	± 20Hz
5. 355kHz BPF	1) MODE : CW STBY : REC	RF V.M	SIG-NAL	Q129-G2	SIG-NAL	L146–148	MAX	0.4V ± 0.1V (reference)
6. 0.1–30MHz BPF (Step 11 must also be performed).	1) BAND : 20.0–30.0MHz FREQ : 29,500.0kHz RF ATT : 0dB STBY : REC Disconnect SIGNAL unit, FRO connector, and connect this plug to detector.	Sweep generator Detector Oscilloscope	Body RF	ANT RIF	SIG-NAL	L43–45	Adjust as shown at right.	
	2) BAND : 14.0–20.0MHz FREQ : 18,000.0kHz					L40–42		
	3) BAND : 8.5–14.0MHz FREQ : 10,000.0kHz					L38–39		
	4) BAND : 7.0–8.5MHz FREQ : 7,000.0kHz					L33–35		
	5) BAND : 4.0–7.0MHz FREQ : 6,900.0kHz					L29–32		
	6) BAND : 3.0–4.0MHz FREQ : 3,900.0kHz					L25–27		

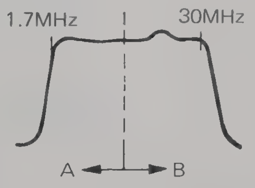
ADJUSTMENT

Item	Condition	Measurement			Adjustment			Specification/Remarks
		Test equipment	Unit	Terminal	Unit	Part	Method	
	7) BAND : 1.5–3.0MHz FREQ : 1,900.0kHz	Sweep generator Detector Oscilloscope	Body RF	ANT RIF	SIG-NAL	L22–24	Adjust as shown at right.	
	8) BAND : 0.5–1.5MHz FREQ : 1,000.0kHz					L18,19		
	9) BAND : 100–500kHz DISPLAY : 300.0kHz					L15–17		
7. 44.93MHz MCF	1) STBY : REC Disconnect SIGNAL unit, VCOF connector, and connect plug to Sweep GEN. Sweep G. To RF unit Detector must be grounded near R336. Reconnect VCOF connector after adjustment.	Sweep generator Detector Oscilloscope	RF SIG-NAL	VCOF R336	SIG-NAL	L121–124	1) Crest value : MAX 2) Ripple : MIN Adjust as shown at right.	 44.93MHz ± 5kHz
8. SSB SLOPE TUNE	1) MODE : CW SSB SLOPE TUNE HIGH CUT CONTROL : MAX (Full CW) LOW CUT CONTROL : MIN (Full CCW) Disconnect XF-6 2P connector and insert set-up jig PC board. NAR-WIDE SW : NAR	VBT-1 Oscilloscope  C419 .022 D123 XF6 R436 C431 .022 .01 50V JIG PC BOARD	SIG-NAL Rear panel	Connector 7-1P IF OUT			Adjust VBT-1 f VR to obtain waveform shown at right.	
	2) NAR-WIDE SW : WIDE Remove jig PC board from XF-6 and reinstall 2P connector.				SIG-NAL	TC3	Adjust as shown at right.	
9. RX IF-AMP (Steps 10,12 must also be performed).	1) FREQ : 14,175.0kHz MODE : USB RF GAIN : CW MAX AGC : OFF SSG output : 14.175MHz	SSG AF V.M Oscilloscope AF dummy load	Rear panel	ANT EXT.SP	RF SIG-NAL	T3–5, TC1 L125–132, 146–148, 165–168,	MAX (AF output) Rotate L126 core out by 30° from peak. T4 : 2.5 turns down from flush then TC1 mechanical center. Then T3 for MAX	S/N : better than 10dB/0.63V (8Ω) with (–6dB) SSG output.  TC1 Mechanical center Note: TC1 ; From S/N 208XXXX–309XXXX
	2) Disconnect SSG	RF VTVM	RF	RIF	RF	VR1	MIN	Note: VR1; from S/N310XXXX–
10. NOTCH (If Step 9 adjustments are perfomed, these adjustments must also be performed).	1) FREQ : 14,175.0kHz MODE : USB NOTCH CONTROL : 1 o'clock SSG output : 14.175MHz 0dB/μ	SSG AF V.M Oscilloscope AF dummy load f. counter	Rear panel	ANT EXT.SP			Adjust for 1500Hz/0.63V AF output.	
	2) NOTCH SW : ON SSG output : 40dB/μ				SIG-NAL	L167 VR28	MIN Adjust while slowly raising SSG output.	
	3) Adjust NOTCH control to verify operating point turn NOTCH SW off after checking.							Dip point must occur between 12 : 30 and 1 : 30.

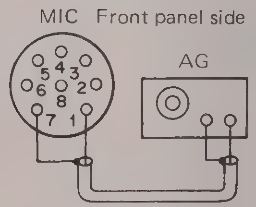
ADJUSTMENT

Item	Condition	Measurement			Adjustment			Specification/Remarks
		Test equipment	Unit	Terminal	Unit	Part	Method	
11. IF trap (If Step 6-1 adjustment is perfomed, this adjustment must also be performed).	1) BAND : 28 MODE : USB SSG output : 44.93MHz 80dB/μ	SSG	Rear panel	ANT	SIG-NAL RF	L11,12 T7	MIN	Almost all received wave-form must disappear.
12. S meter (If TC1 is adjusted in step 9 perform this adjustment).	1) AGC : OFF METER SW : POWER	S meter			SIG-NAL	VR30	Set to S meter starting point.	
	2) FREQ : 14,175.0kHz AGC : FAST SSG output : 14.175MHz 0dB/μ	SSG S meter AF V.M Oscillo-scope AF dummy load	Rear panel	ANT EXT.SP		VR1	Adjust CCW to the point where AF V.M reading decreases by 0.5dB.	
	3) SSG output : 8dB/μ					TC1	S1	8dB ± 4dB
	4) SSG output : 40dB/μ					VR31	S9	40dB ± 6dB
	5) SSG output : 100dB/μ						SSG output : 100dB Repeat step 1) through 4) if necessary.	S9 + 60dB ± 6dB Check
13. NB	1) FREQ : 14,175.0kHz MODE : USB SSG output : 14,175.0kHz	SSG DC V.M	Rear panel SIG-NAL	ANT R144	SIG-NAL	L80,81	1) MIN (SSG output : 20dB) Lower SSG output to the point where DC voltage falls slightly, and again reset to MIN.	
	2) MODE : USB NB LEVEL : CCW	Moise GEN. S meter	Rear panel	ANT			Adjust Noise GEN. level to read to S1.	
	3) NB 1 SW : ON Adjust NB LEVEL control to the point where N.B. action begins. (After checking, turn NB 1 SW : OFF)				SIG-NAL	L80,81	MIN (If NB level has insufficient effect, adjust L126 core slightly CCW (out) from peak.	Noise disappears.
	4) NB 2 SW : ON (After checking, shut NB 2 SW OFF)						Check	The same effect as NB 1 is obtained.
	5) Raise Noise GEN. level to S9. NB 1 SW : ON (After checking, turn NB 1 SW OFF).						If any noise remains adjust NB LEVEL to find the point where NB operates.	Noise disappears.
14. Micro-processor Audio-Tone indicator	1) AF GAIN : MIN CLEAR SW : Push	AF V.M Oscillo-scope AF dummy load	Rear panel	EXT.SP	SIG-NAL	VR33	50mV/8Ω	± 3dB

TX ADJUSTMENT

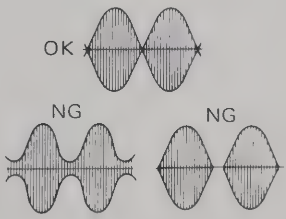
Item	Condition	Measurement			Adjustment			Specification/Remarks
		Test equipment	Unit	Terminal	Unit	Part	Method	
1. TX-BPF	1) FREQ : 14,175.0kHz STBY : SEND Disconnect DRV connector and terminate with a 50Ω dummy load. (After adjustment, remove and reconnect DRV connector).	Sweep generator Detector Oscillo-scope	SIG-NAL	R196 DRV	SIG-NAL	L92–88, L84	Adjust in order, L92–88,84 so that waveform shown at right is obtained when crest value is MAX. (Adjust sweep band A and B separately).	

ADJUSTMENT

Item	Condition	Measurement			Adjustment			Specification/Remarks
		Test equipment	Unit	Terminal	Unit	Part	Method	
2. Drive	1) FREQ : 14,175.0kHz MODE : CW Disconnect DRV connector and terminate with a 50Ω dummy load. Adjust CAR control for DRV terminal voltage is less than 1.5V. STBY : SEND	RF V.M	SIGNAL	DRV	SIGNAL	L94–99, 111, 112, 115, 132	MAX 1) Adjust in order; L115, 112–94 and 132. 2) Repeat in order; L99, 111, and 94–97.	
3. TX IF-AMP	1) FREQ : 14,175.0kHz MODE : USB Disconnect DRV connector and terminate with a 50Ω dummy load. Adjust MIC control so voltage at DRV terminal is 1.0V ± 0.5V. AG output : 1500Hz, 2mV STBY : SEND	RF V.M AG	SIGNAL Front panel	DRV MIC	SIGNAL	L152, 153, 134, 133, 112	MAX 1) Adjust in order ; L152,153,134,133 and 112. 2) Repeat in order ; L152 and 153.	 MIC Front panel side AG 1 2 3 4 5 6 7 8
4. IC METER φ point	1) METER SW : IC Disconnect connector in the FINAL unit, 28V line. STBY : SEND (After adjustment, reconnect this connector).	S meter			SIGNAL	VR18	IC meter reads φ (start) point.	
5. 100W FINAL BIAS	1) FREQ : 14,175.0kHz MODE : USB MIC CONTROL : MIN Desolder L7 lead and connect ammeter in its place, minus to L7 side. STBY : SEND (After adjustment, resolder L7 lead.)	DC ammeter	FINAL	L7	FINAL	VR2	70mA Note: Stabilization requires approximately 20 seconds.	± 10mA
	2) FINAL unit VR1 : MIN Disconnect connector in FINAL unit, 28V line and connect ammeter in its place. STBY : SEND (Disconnect ammeter and reconnect this connector after adjustment.)					VR1	1.3A	1.1–1.5A
6. IC meter	1) FREQ : 14,175.0kHz MODE : CW Disconnect connector in FINAL unit, 28V line (Plus side) and connect ammeter in its place. STBY : SEND (Adjust CAR control to draw 10A current.)	DC ammeter			SIGNAL	VR17	10A	
	2) Adjust CAR control for 2A current. (Disconnect ammeter and reconnect this connector after adjustment.)						IC meter 2A	± 0.3A Check
7. Current limiter (If this adjustment is performed, Step 8 must also be performed.)	1) FREQ : 14,175.0kHz MODE : CW CAR CONTROL : MAX	DC ammeter	FINAL	28V line connector				
	Adjust SIGNAL unit, VR8 in advance for 10A current. STBY : SEND	DC V.M	SIGNAL	Q49-B	SIGNAL	VR10	0.42V	

ADJUSTMENT

○ : From S/N 208XXXX–309XXXX
● : From S/N 310XXXX–

Item	Condition	Measurement			Adjustment			Specification/Remarks
		Test equipment	Unit	Terminal	Unit	Part	Method	
8. Power	1) FREQ : 14,175.0kHz MODE : CW CAR CONTROL : MAX STBY : SEND	Power meter	Rear panel	ANT	SIG-NAL	VR8	110W	Not to exceed 125W
9. Power meter	1) FREQ : 14,175.0kHz MODE : CW STBY : SEND CAR CONTROL : Set for external power meter reading of 100W.	Power meter S meter	Rear panel	ANT	SIG-NAL	VR14	110W	± 5W
10. AM power From S/N 208XXXX–309XXXX	1) FREQ : 28.1MHz MODE : AM MIC CONTROL : MAX STBY : SEND	Power meter	Rear panel	ANT	SIG-NAL	L175 VR22	Adjust for MAX power with L175, then set to 30W with VR22.	± 3W Note : AM power can be adjusted by CAR control at front panel from S/N 310XXXX.
11. Tune power setting	1) FREQ : 14,175.0kHz MODE : TUNE CAR CONTROL : MAX STBY : SEND	Power meter	Rear panel	ANT	SIG-NAL	VR7	55W	
12. Protection	1) FREQ : 14,175.0kHz MODE : CW CAR CONTROL : MAX METER SW : POWER ANT : OPEN STBY : SEND	S meter			SIG-NAL	VR9	10W	± 2.5W
13. SWR meter	1) FREQ : 3,575.0kHz MODE : CW CAR CONTROL : MAX STBY : SEND	150Ω dummy load S meter	Rear panel	ANT	SIG-NAL	VR16	SWR 3	
	2) STBY : SEND	Power meter (50Ω) S meter					Check	SWR 1.2 or less
14. Vc meter	1) FREQ : 14,175.0kHz MODE : USB MIC CONTROL : MIN METER SW : VC STBY : SEND	Power meter S meter	Rear panel	ANT	SIG-NAL	VR19	28.5V (Power voltage)	± 0.5V
15. SSB mode Frequency response	1) FREQ : 14.175,0kHz MODE : USB AG output : 2 tone, 7mV 300Hz, 2700Hz ; ○, 300Hz, 2900Hz ; ● Adjust MIC control for 50W. STBY : SEND	Power meter Oscilloscope AG	Rear panel Front panel	ANT (Directional coupler) MIC	SIG-NAL	TC4	Adjust as shown at right. (Equal 300Hz, 2700Hz ; ○ , 300Hz, 2900Hz ; ● amplitude within 5W).	
	2) MODE : LSB STBY : SEND					TC5		
	3) MODE : USB, LSB AG output : 1500Hz, 5mV STBY : SEND						Calibrate oscilloscope.	
	4) MODE : USB, LSB AG output : 2600Hz, 5mV STBY : SEND						Check	Within 6dB (at 1500Hz).
	5) MODE : USB, LSB AG output : 400Hz, 5mV STBY : SEND							
	6) Check carrier suppression after this adjustment.				SIG-NAL	TC2 VR21	MIN	–40dB or less.

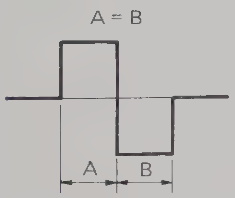
ADJUSTMENT

Item	Condition	Measurement			Adjustment			Specification/Remarks
		Test equipment	Unit	Terminal	Unit	Part	Method	
16. Carrier suppression (If step 15 is performed, this adjustment must also be performed.)	1) FREQ : 14,175.0kHz MODE : USB ↔ LSB MIC CONTROL : MIN STBY : SEND	Oscilloscope (Spectrum analyzer)	Rear panel	ANT (through Directional coupler)	SIGNAL	TC2 VR21	MIN (Adjust alternately.) Adjust for no difference between USB and LSB.	
	2) MODE : CW CAR CONTROL : MAX STBY : SEND						Calibrate Oscilloscope (Spectrum analyzer.)	
	3) MODE : USB ↔ LSB STBY : SEND						Check If less than −40dB, repeat adjustment 1).	−40dB or less
17. ALC meter	1) FREQ : 14,175.0kHz MODE : USB METER SW : ALC MIC CONTROL : MIN AG output : 1500Hz, 5mV STBY : SEND	S meter Power meter AG	Rear panel Front panel	ANT MIC	SIGNAL	VR11	Set to starting point of ALC meter.	
	2) MIC CONTROL : Adjust for ALC meter start point. STBY : SEND							
	3) AG output : 10mV STBY : SEND					VR12	Adjust for maximum ALC zone reading.	
18. Speech processor	1) FREQ : 14,175.0kHz MODE : USB METER SW : COMP PROC SW : ON AG output : 1500Hz, 1mV PROCESSOR OUT CONTROL : MIN MIC CONTROL : MIN STBY : SEND Adjust meter with PROCESSOR IN Control.	S meter Power meter AG	Rear panel Front panel	ANT MIC	SIGNAL	L136	Adjust for maximum COMP meter reading.	
	2) PROCESSOR IN CONTROL: Set to COMP meter starting point. STBY : SEND							
	3) AG output : + 20dB (10mV) STBY : SEND					VR20	Adjust for 20dB COMP meter.	
	4) METER SW : ALC STBY : SEND PROCESSOR IN CONTROL: ALC zone maximum.					L135	Adjust for maximum ALC zone reading.	
19. Monitor level	1) FREQ : 14,200.0kHz MODE : USB CAL SW : ON	AF V.M Oscilloscope AF dummy load	Rear panel	EXT. SP			Receive marker, and adjust AF gain for 0.63V/8Ω output.	
	2) METER SW : ALC MONI SW : ON AG output : 1kHz, 10mV MIC CONTROL : within ALC zone. AGC : FAST STBY : SEND	Power meter AG	Rear panel Front panel	ANT MIC	SIGNAL	L113 VR34	1) L113 : Monitor output maximum. 2) VR32 : 0.63V/8Ω.	± 3dB

ADJUSTMENT

Item	Condition	Measurement			Adjustment			Specification/Remarks
		Test equipment	Unit	Terminal	Unit	Part	Method	
	3) MIC VR : MIN Remove AG from MIC terminal STBY : SEND						Check hum and noise.	1.5mV/8Ω or less
20. MIX balance	1) FREQ : 21,100.0kHz MODE : AM MIC CONTROL : MIN STBY : SEND	Power meter Monitor receiver (Spectrum analyzer)	Rear panel	ANT	SIGNAL	VR6	21.555MHz : MIN (S meter and AF output.)	
	2) MODE : CW					VR3	21.900MHz : MIN (S meter and AF output.)	
	STBY : SEND					VR2	23.850MHz : MIN (S meter and AF output.)	
21. Side tone	1) MODE : CW AF GAIN : 12 O'clock PITCH CONTROL : 12 O'clock MONI SW : ON	AF V.M Oscilloscope f. counter	Rear panel	EXT. SP	SIGNAL	VR32	0.63V/8Ω 800Hz	± 100Hz
	2) PITCH CONTROL : MIN ↔ MAX						Check	800Hz ± 300Hz or more.

ANTENNA TUNER

Item	Condition	Measurement			Adjustment			Specification/Remarks
		Test equipment	Unit	Terminal	Unit	Part	Method	
AT-930 Auto antenna tuner (If installed)	1) FREQ : 29,700.0kHz MODE : TUNE CAR VR : MAX METER : SWR STBY : SEND Adjust VR1 so that the motors do not stop at all.	150Ω RF dummy load	Rear panel	ANT	AT	TC1	Adjust TC1 to minimize the angle of motor rotation between points at which the motors are alternately reversed.	
	2) FREQ : 3,500.0kHz First tune, then REC							
	Disconnect the ④ connector. STBY : SEND Turn VFO frequency (up) untill SWR becomes "2".	Oscilloscope	AT	J12	AT	VR2	Adjust as shown at right.	
	3) STBY : SEND Turn VFO frequency (down) untill SWR becomes "1.15" After adjustment. STBY : REC Reconnect the ④ connector.					VR1	Adjust VR1 until ANT TUN indicator just goes off.	
	4) FREQ : Check at the following frequencies. Order Frequency 1 1.900.0kHz 2 3,750.0 3 7,150.0 4 14,175.0 5 21,225.0 6 28,800.0						Check	SWR 1.2 or less.

ADJUSTMENT

MICROPROCESSOR OPERATION CHECK

<table>
<tr><th>Item</th><th>Condition</th><th colspan="3">Operation check</th></tr>
<tr><td rowspan="4">1. Reset</td><td>1) Turn POWER SW off and (If installed remove backup batteries, then ground IC13 (μPD5101LC) pin 22 on Digital unit to reset. If backup batteries are not installed, and POWER SW has been off 24 hours or more, reset is complete. (In all other cases, functions set before POWER SW was turned off are backed up.
FUNCTION SW : A
POWER SW : ON</td><td colspan="3">FREQ : 14,000.0kHz
20kHz display : 0kHz
VFO-A is displayed.</td></tr>
<tr><td>2) FUNCTION SW : B
Same as 1).</td><td colspan="3">FREQ : 14,000.0kHz
VFO-B is displayed.</td></tr>
<tr><td>3) VFO/MEMO SW : MEMO
M.CH SW : 1–8
Same as 1).</td><td colspan="3">FREQ ; 14,000.0kHz
MEMO is displayed.</td></tr>
<tr><td>4) FUNCTION SW : A
VFO/MEMO SW : VFO</td><td colspan="3"></td></tr>
<tr><td rowspan="19">2. BAND</td><td>1) BAND SW : 1MHz
Depress STEP UP once.</td><td colspan="3">$\boxed{1}\boxed{5}$,000.0 is displayed and tone sounds. (sounds continuously if SW is continuously depressed.)</td></tr>
<tr><td>Then, depress repeatedly</td><td colspan="3">□□, MHz display advances in 1MHz steps and stops at 29. Tone sounds at each step.</td></tr>
<tr><td>2) BAND SW : 1MHz
Depress STEP DOWN once.</td><td colspan="3">$\boxed{2}\boxed{8}$,000.0 is displayed and tone sounds.</td></tr>
<tr><td>Then, depress repeatedly.</td><td colspan="3">□□, MHz display decreases in 1MHz steps and stops at ⬚⬚,100.0. tone sounds at each step.</td></tr>
<tr><td rowspan="15">3) BAND SW : 1.5 → 3.5 → 7 → 10 → 14 → 18 → 21 → 24.5 → 28 → 29 → 21 → 28 → 14

Depress each of the amateur band switches in the order as shown at the right. Insure that display is as shown in the table.</td><td>SW</td><td>FREQ. Display</td><td>20kHz Analog Display</td></tr>
<tr><td>1.5</td><td>1,600.0</td><td>600</td></tr>
<tr><td>3.5</td><td>3,600.0</td><td>600</td></tr>
<tr><td>7</td><td>7,100.0</td><td>100</td></tr>
<tr><td>10</td><td>10,100.0</td><td>100</td></tr>
<tr><td>14</td><td>14,100.0</td><td>100</td></tr>
<tr><td>18</td><td>18,100.0</td><td>100</td></tr>
<tr><td>21</td><td>21,100.0</td><td>100</td></tr>
<tr><td>24.5</td><td>24,600.0</td><td>600</td></tr>
<tr><td>28</td><td>28,600.0</td><td>600</td></tr>
<tr><td>29</td><td>29,600.0</td><td>600</td></tr>
<tr><td>21</td><td>21,100.0</td><td>100</td></tr>
<tr><td>28</td><td>28,100.0</td><td>100</td></tr>
<tr><td>14</td><td>14,100.0</td><td>100</td></tr>
<tr><td colspan="3"></td></tr>
</table>

Item	Condition	Operation check
3. Dial step	1) FREQ. (Display) : 150kHz Confirm that the display does not change when the VFO is turned counterclockwise. Turn VFO slowly clockwise.	VFO Scale 1 division : 500Hz 1 turn : 10kHz When VFO is advanced two turns, the 20kHz scale advances one step.
	2) Turn VFO knob at a speed of 5–6 turns/sec. (or faster.)	Confirm that the step speed of both the display and analog scale (Rate of change) increases.
	3) Repeat test for counterclockwise rotation.	Confirm alternate tuning direction operation.
4. RIT	1) RIT SW : ON	RIT $\boxed{\text{ON}}$ is displayed and tone sounds. (Tone is continuous while SW is depressed.)
	2) FREQ : □□,□10.0kHz. RIT SW : ON RIT CONTROL : Clockwise Counterclockwise	Display indicates: 1) Upper limit VFO : □□,□20.0kHz RIT : 9.9kHz 2) Lower limit VFO : □□,□00.0kHz RIT : –9.9kHz
	3) RIT SW : ON/OFF RIT FREQ : 9.9kHz	RIT : ON (Tone sounds.) VFO : □□,□20.0kHz RIT : 9.9kHz RIT : OFF (Tone sounds.) VFO : □□,□10.0kHz RIT : 9.9kHz
	4) RIT SW : ON RIT FREQ : + 9.9kHz RIT CLEAR SW : ON	VFO : □□,□10.0kHz RIT : 0.0kHz (Tone sounds.)
	5) RIT SW : OFF	RIT $\boxed{\text{ON}}$ display goes off and tone sounds.
5. Memory write	1) FREQ : 1,900.0kHz M.CH SW : 1 MIN SW : ON	When MIN SW is depressed, tone sounds. (If continuously depressed tone sounds continuously.)
	2) FREQ : 3,575.0kHz M.CH SW : 2 MIN SW : ON	
	3) FREQ : 7,150.0kHz M.CH SW : 3 MIN SW : ON	
	4) FREQ : 10,125.0kHz M.CH SW : 4 MIN SW : ON	
	5) FREQ : 14,175.0kHz M.CH SW : 5 MIN SW : ON	
	6) FREQ : 21,225.0kHz M.CH SW : 6 MIN SW : ON	
	7) FREQ : 24,950.0kHz M.CH SW : 7 MIN SW : ON	
	8) FREQ : 28,800.0kHz M.CH SW : 8 MIN SW : ON	

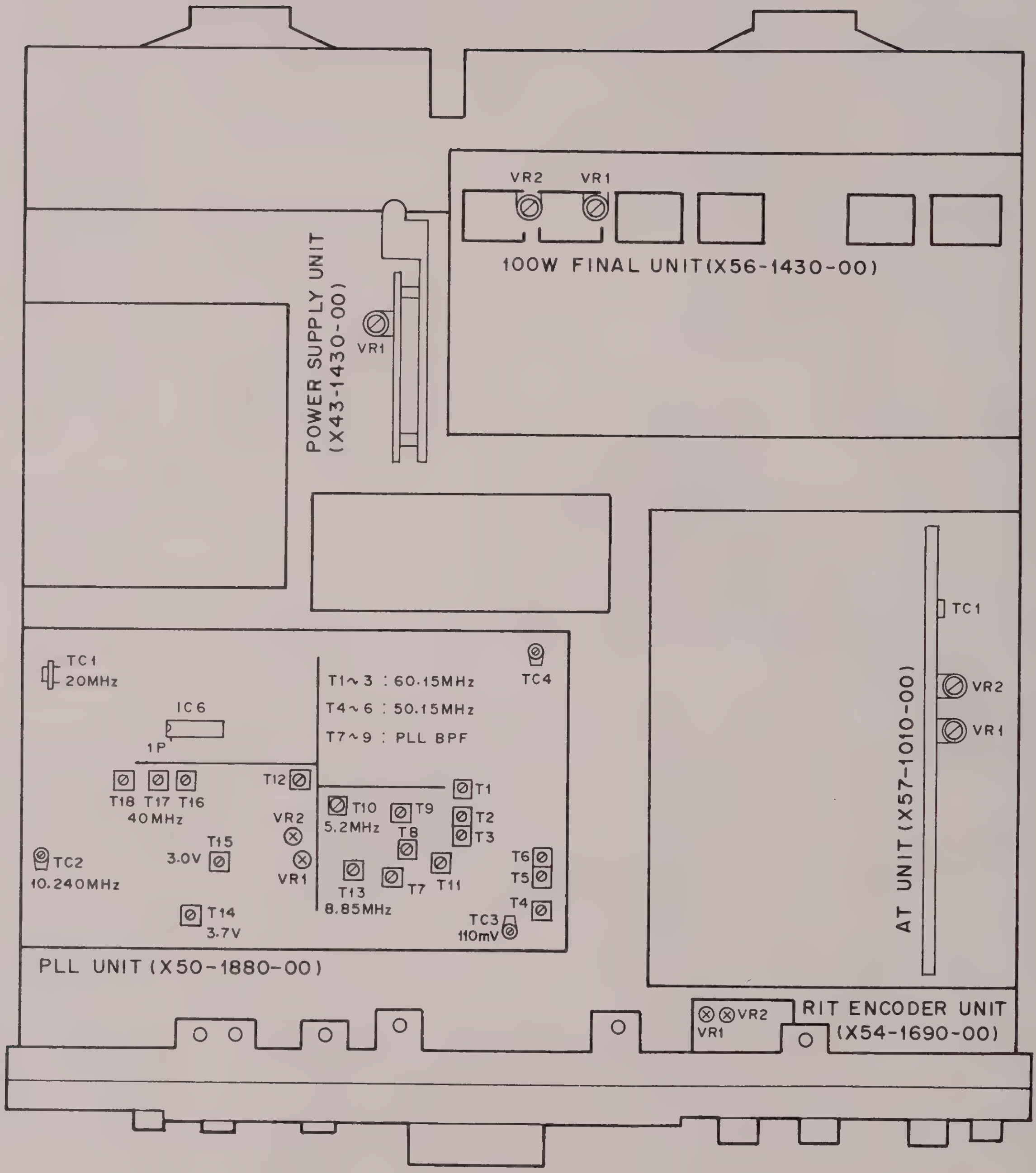
ADJUSTMENT

Item	Condition	Operation check	
6. Memory Recall (1)	1) M.CH SW : 1 MR SW : ON	FREQ : 1,900.0kHz 20kHz analog display : 900	
	Tune VFO up and down.	Displayed frequency increases or decreases.	
	Depress MIN SW again.	Display returns to starting FREQ : 1,900.0kHz, and analog display : 900.	
	2) MODE : LSB MIC CONTROL : MIN STBY : SEND (Return to REC after check.)	FREQ : 1,900.0kHz ANALOG : 900	
	3) MR SW : ON	FREQ.	ANALOG
	M.CH : 2	3,575.0kHz	740
	: 3	7,150.0kHz	140
	: 4	10,125.0kHz	120
	: 5	14,175.0kHz	160
	: 6	21,225.0kHz	220
	: 7	24,950.0kHz	940
	: 8	28,800.0kHz	800
7. Memory Recall (2)	1) VFO/MEMO : MEMO M.CH SW : 1	FREQ : 1,900.0kHz ANALOG : 900	
	Tune VFO up and down.	Display does not change.	
	2) MODE : LSB MIC CONTROL : MIN STBY : SEND (Return to REC after check.)	FREQ : 1,900.0kHz ANALOG : 900	
	3)	FREQ	ANALOG
	M.CH SW : 2	3,575.0kHz	740
	: 3	7,150.0kHz	140
	: 4	10,125.0kHz	120
	: 5	14,175.0kHz	160
	: 6	21,225.0kHz	220
	: 7	24,950.0kHz	940
	: 8	28,800.0kHz	800
	(Return VFO/MEMO SW to VFO after check.)		

Item	Condition	Operation check
8. A=B (FUNCTION)	1) FUNCTION SW : A FREQ : 14,175.0kHz	FREQ : 14,175.0kHz ANALOG : 160
	2) FUNCTION SW : B FREQ : 21,225.0kHz	FREQ : 21,225.0kHz ANALOG : 220
	3) FUNCTION SW : A A=B SW : ON FUNCTION SW : B	FREQ : 14,175.0kHz ANALOG : 160 When A=B SW is depressed, tone sounds.
	4) FUNCTION SW : A FREQ : 14,175.0kHz	FREQ : 14,175.0kHz ANALOG : 160
	5) FUNCTION SW : B FREQ : 21,225.0kHz	FREQ : 21,225.0kHz ANALOG : 220
	A=B SW : ON FUNCTION SW : A	When A=B SW is depressed, tone sounds.
9. MIC UP/DOWN	1) MODE : USB Connect microphone (MC-60S8 or MC-42S). Depress UP button several times.	When depressed ten times, display increases by 100Hz.
	2) Continuously depress UP button.	When depressed, display increases at 10Hz intervals, and speed becomes gradually faster.
	3) Depress DOWN button several times.	When depressed ten times, display decreases by 100Hz.
	4) Continuously depress DOWN button.	When depressed, display increases at 10Hz intervals and speed becomes gradually faster.
10. D. LOCK	1) D.LOCK SW : ON Turn VFO clockwise or counterclockwise	FREQ. set before D.LOCK was engaged is displayed and does not change.
	2) RIT SW : ON Adjust RIT CONTROL up or down.	Both main, and RIT frequencies change.
	RIT CLEAR SW : ON (Turn off RIT after check.)	Display returns to original FREQ. set before RIT test.
	3) Continuously depress up or down microphone switch.	FREQ. Display increases or decreases regardless of D. LOCK.

ADJUSTMENT

TOP VIEW

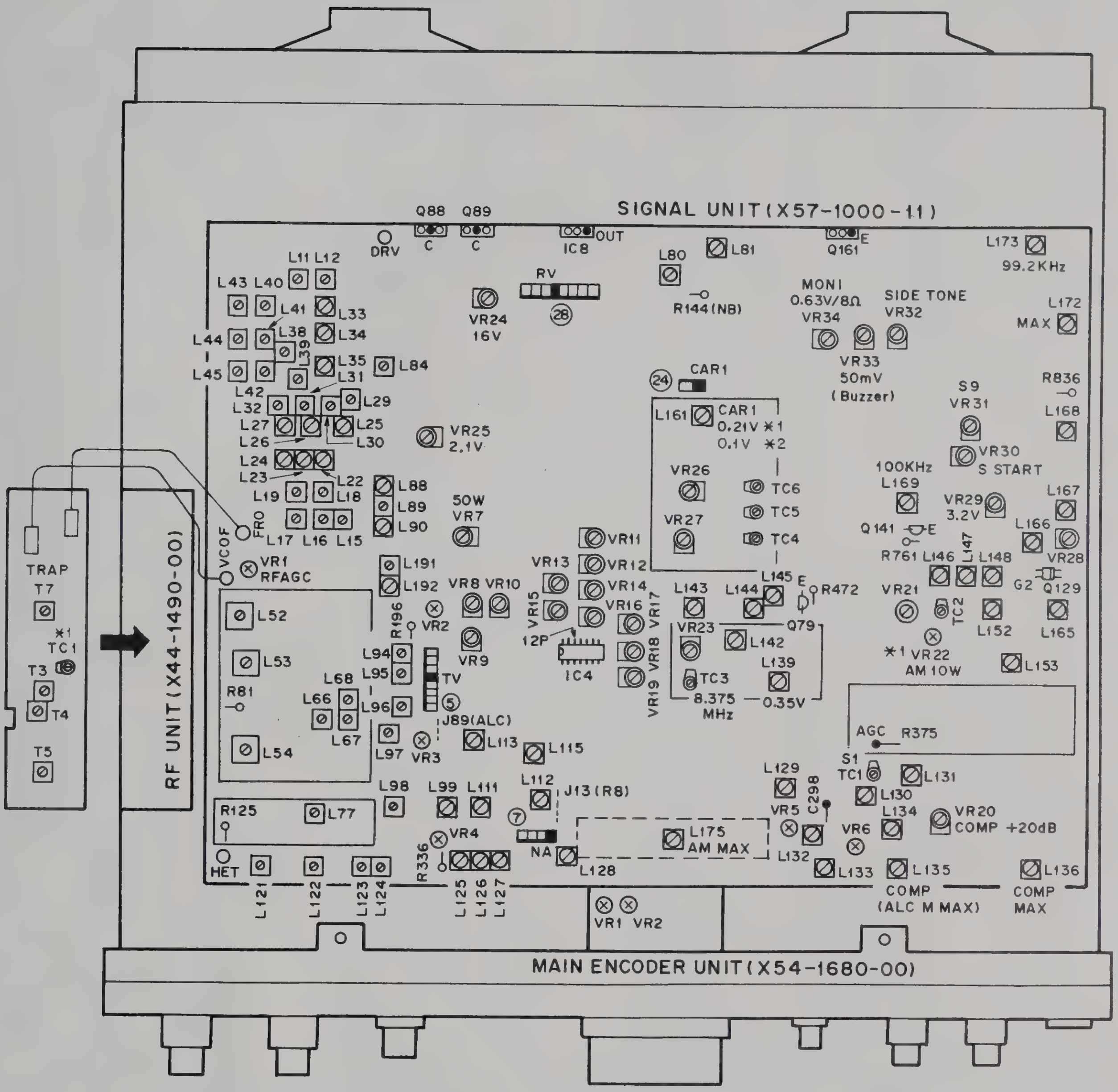

VR2
VR1
100W FINAL UNIT(X56-1430-00)
POWER SUPPLY UNIT
(X43-1430-00)
VR1
TC1
AT UNIT (X57-1010-00)
VR2
VR1
TC1
20MHz
IC6
1P
T1~3 : 60.15MHz
T4~6 : 50.15MHz
T7~9 : PLL BPF
TC4
T12
T18 T17 T16
40MHz
T1
T10
5.2MHz
T9
T8
T2
T3
VR2
VR1
T15
3.0V
TC2
10.240MHz
T6
T5
T4
T13
8.85MHz
T7
T11
T14
3.7V
TC3
110mV
PLL UNIT (X50-1880-00)
VR2
VR1
RIT ENCODER UNIT
(X54-1690-00)

Caution: Use extreme care when working on energized equipment in the areas of the power transformer, and the ON/OFF switch, as there is voltage present even with the ON/OFF switch in the OFF position.

ADJUSTMENT

BOTTOM VIEW

✱1 : From S/N208XXXX−309XXXX
✱2 : From S/N310XXXX−


SIGNAL UNIT (X57-1000-11)
RF UNIT (X44-1490-00)
MAIN ENCODER UNIT (X54-1680-00)
Q88 C
Q89 C
DRV
IC8 OUT
Q161 E
L173 99.2KHz
L80
L81
R144 (NB)
MONI 0.63V/8Ω VR34
SIDE TONE VR32
VR33 50mV (Buzzer)
L172 MAX
RV
VR24 16V
㉘
㉔
CAR1
L161 CAR1 0.21V ✱1 0.1V ✱2
S9 VR31
R836
L168
VR30 S START
100KHz L169
VR29 3.2V
L167
L166
VR28
Q141 E
R761 L146 L147 L148
G2 Q129
VR21
TC2
L152
L165
✱1 VR22 AM 10W
L153
AGC R375
S1 TC1
L131
L130
L134
VR20 COMP +20dB
L135 COMP (ALC M MAX)
L136 COMP MAX
L133
VR6
L132
VR5
C298
L129
L175 AM MAX
VR26
VR27
TC6
TC5
TC4
L145 E R472
L143 L144
VR23
Q79
L142
TC3 8.375 MHz
L139 0.35V
VR11
VR12
VR14
VR16
VR17
VR18
VR19
VR13
VR15
12P
IC4
50W VR7
VR8 VR10
VR9
VR2
R196
L191
L192
L94
L95
L96
TV
⑤
J89 (ALC)
L113
L115
L112
J13 (R8)
⑦
NA
L128
L99 L111
L98
VR4
R336
L125 L126 L127
L121 L122 L123 L124
HET
R125
L77
L97
VR3
L11 L12
L43 L40
L41
L33
L34
L44
L38
L39
L35
L31
L84
L45
L42
L32
L29
L27
L25
L26
L30
VR25 2.1V
L24
L23
L22
L88
L89
L90
L19
L18
L17 L16 L15
FRO
VCOF
VR1 RFAGC
L52
L53
L54
R81
L68
L66
L67
TRAP T7
✱1 TC1
T3
T4
T5
VR1 VR2

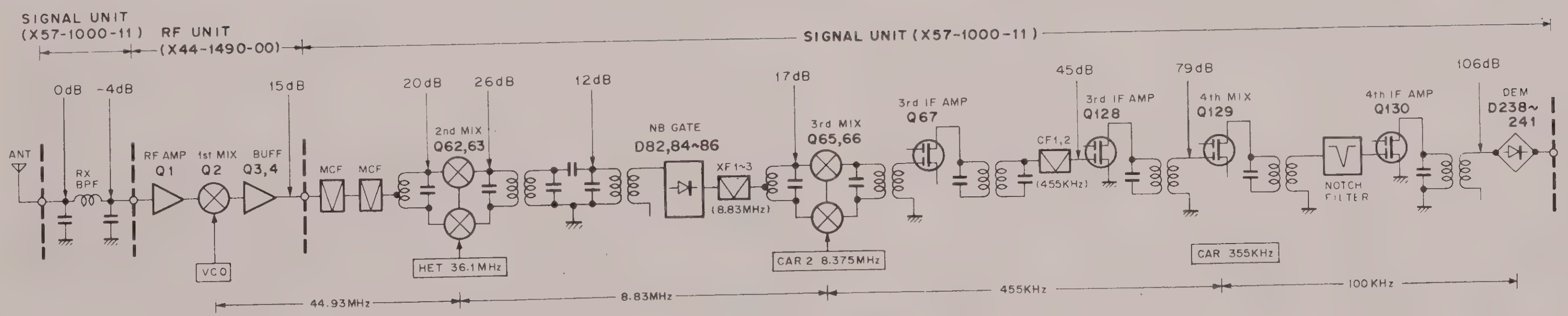
L15−17 : 100−500kHz
L18,19 : 0.5−1.5MHz
L22−24 : 1.5−3.0MHz
L25−27 : 3−4MHz
L29−32 : 4−7MHz
L33−35 : 7−8.5MHz
L38,39 : 8.5−14MHz
L40−42 : 14−20MHz
L11,12,43−45 : 20−30MHz
L52 : 29.9999MHz, 13.0V
L53 : 9.5000MHz
L54 : 45.03MHz±1kHz
L66−68 : 45−75MHz BPF
L113 : MONI MAX
L122 : 44.93MHz MCF
TC2 : TX CAR SUPPRESSION
TC4 : USB FREQUENCY RESPONSE (TX)
TC5 : LSB FREQUENCY RESPONSE (TX)
TC6 : CW 8.830MHz

VR2 : 23.85MHz (TX)
VR3 : 21.900MHz (TX)
VR6 : 21.555MHz (TX)
VR8 : POWER (TX)
VR9 : PROTECTION (TX)
VR10 : 0.42V (TX)
VR11 : ALCϕ
VR12 : ALC ZONE
VR13 : 3.2V
VR14 : POWER METER
VR15 : SWR STD 0.5V
VR16 : SWR
VR17 : 10A
VR18 : ICϕ (TX)
VR19 : 28.5V
VR21 : TX CAR SUPPRESSION
VR26 : 8827.79kHz FSK

TS-930S LEVEL DIAGRAM

LEVEL DIAGRAM From S/N 208XXXX–309XXXX

RECEIVER SECTION


SIGNAL UNIT (X57-1000-11)
RF UNIT (X44-1490-00)
SIGNAL UNIT (X57-1000-11)
0dB
-4dB
15dB
20dB
26dB
12dB
17dB
45dB
79dB
106dB
ANT
RX BPF
RF AMP Q1
1st MIX Q2
BUFF Q3,4
VCO
MCF
MCF
2nd MIX Q62,63
HET 36.1MHz
NB GATE D82,84~86
XF1~3 (8.83MHz)
3rd MIX Q65,66
CAR 2 8.375MHz
3rd IF AMP Q67
CF1,2 (455KHz)
3rd IF AMP Q128
4th MIX Q129
CAR 355KHz
NOTCH FILTER
4th IF AMP Q130
DEM D238~241
44.93MHz
8.83MHz
455KHz
100KHz

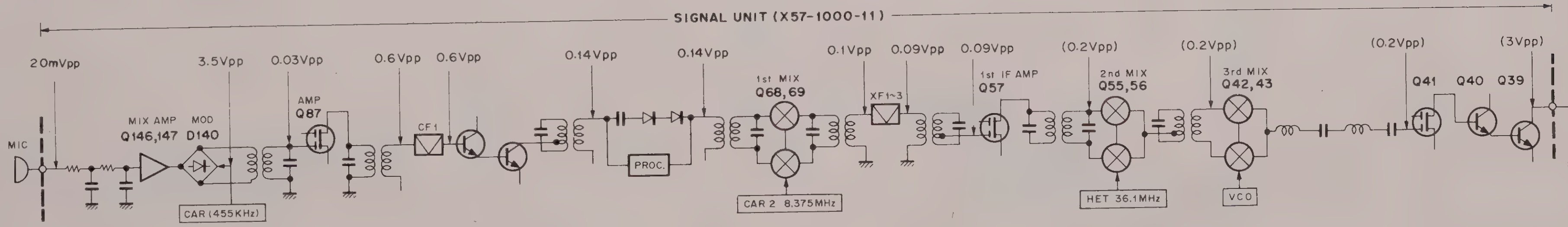
FREQUENCY : 14.200MHz
INPUT : Japanese SSG 0dB
American SSG 0.5μV
AF OUTPUT : 0.63V at 8Ω

NOTES

1) The figures shown are signal generator output required for a constant audio output with a constant AF gain control setting. Set the AF gain control for 0.63V/8Ω (50mW) audio output at 0dB signal generator input at 14.200MHz.

2) To measure signal generator output connect a 0.01μF 500WV capacitor between the signal generator and the check point.

TRANSMITTER SECTION

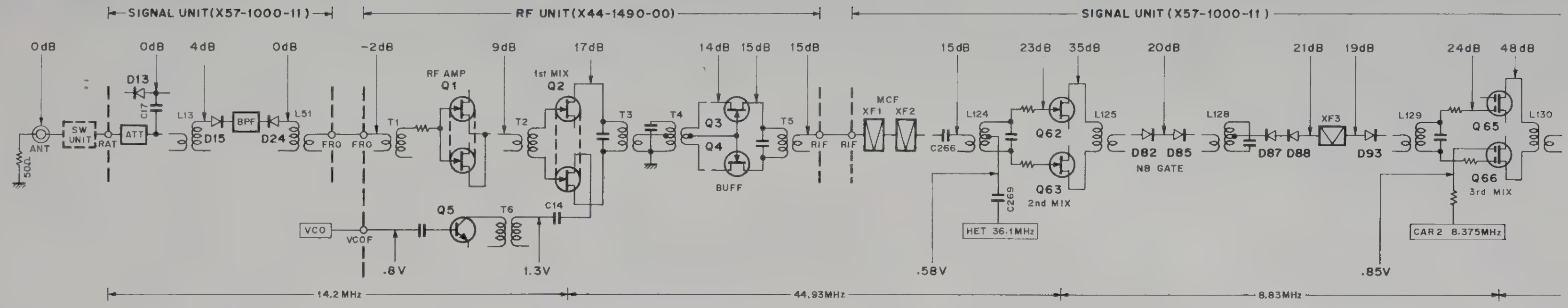

SIGNAL UNIT (X57-1000-11)
20mVpp
3.5Vpp
0.03Vpp
0.6Vpp
0.6Vpp
0.14Vpp
0.14Vpp
0.1Vpp
0.09Vpp
0.09Vpp
(0.2Vpp)
(0.2Vpp)
(0.2Vpp)
(3Vpp)
MIC
MIX AMP Q146,147
MOD D140
CAR (455KHz)
AMP Q87
CF1
PROC.
1st MIX Q68,69
CAR 2 8.375MHz
XF1~3
1st IF AMP Q57
2nd MIX Q55,56
HET 36.1MHz
3rd MIX Q42,43
VCO
Q41
Q40
Q39
50Ω LOAD

FREQUENCY : 14.200MHz
MIC INPUT : 20mVpp 1.5kHz

( ) : Adjust MIC input level so that the voltage at the 50Ω dummy load is 3VPP.

LEVEL DIAGRAM From S/N 310XXXX–

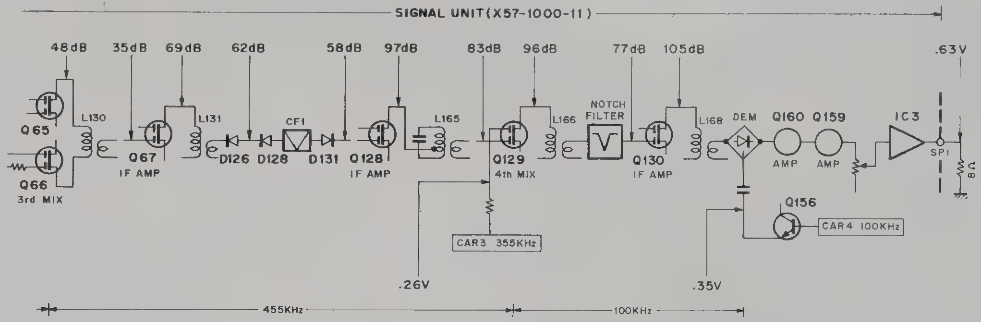
RECEIVER SECTION


SIGNAL UNIT(X57-1000-11)
RF UNIT(X44-1490-00)
SIGNAL UNIT (X57-1000-11)
0dB
0dB
4dB
0dB
-2dB
9dB
17dB
14dB
15dB
15dB
15dB
23dB
35dB
20dB
21dB
19dB
24dB
48dB
ANT
50Ω
SW UNIT
RAT
ATT
D13
C17
L13
D15
BPF
D24
L51
FRO
FRO
T1
RF AMP
Q1
T2
1st MIX
Q2
T3
T4
Q3
Q4
BUFF
T5
RIF
RIF
MCF
XF1
XF2
C266
L124
Q62
Q63
2nd MIX
L125
C269
HET 36.1MHz
D82 D85
NB GATE
L128
D87 D88
XF3
D93
L129
Q65
Q66
3rd MIX
L130
CAR2 8.375MHz
VCO
VCOF
Q5
T6
C14
.8V
1.3V
.58V
.85V
14.2MHz
44.93MHz
8.83MHz

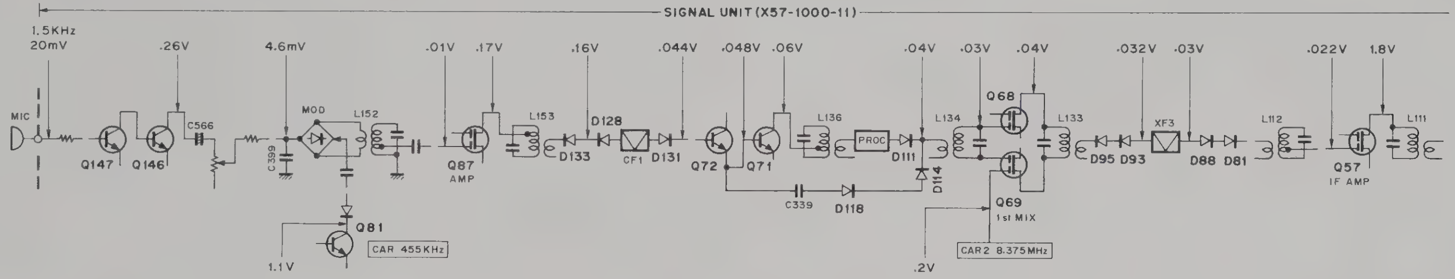
FREQUENCY : 14.200MHz
INPUT : Japanese SSG 0dB (American SSG 0.5μV)
AF OUTPUT : 0.63V/8Ω

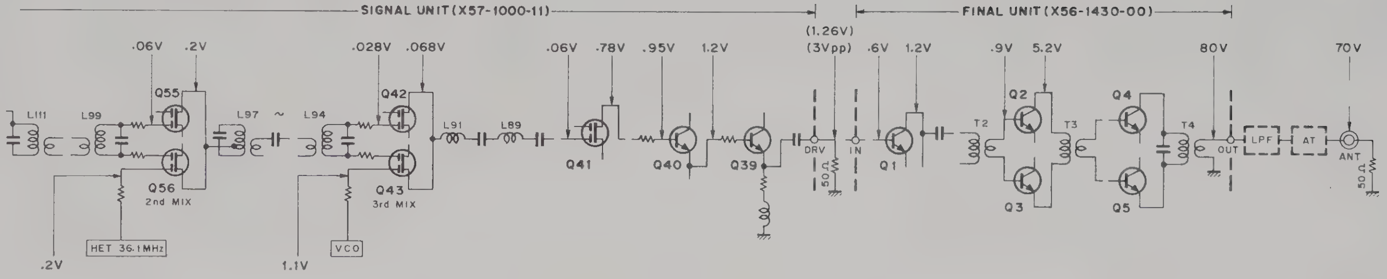
NOTES

1) The figures shown are signal generator output required for a constant audio output with a constant AF gain control setting. Set the AF gain control for 0.63V/8Ω (50mW) audio output at 0dB signal generator input at 14.200MHz.
2) To measure signal generator output connect a 0.01μF 500WV capacitor between the signal generator and the check point.


SIGNAL UNIT(X57-1000-11)
48dB
35dB
69dB
62dB
58dB
97dB
83dB
96dB
77dB
105dB
.63V
Q65
Q66
3rd MIX
L130
Q67
IF AMP
L131
CF1
D126 D128
D131
Q128
IF AMP
L165
Q129
4th MIX
L166
NOTCH FILTER
Q130
IF AMP
L168
DEM
Q160
Q159
AMP
AMP
IC3
SP1
8Ω
Q156
CAR4 100KHz
CAR3 355KHz
.26V
.35V
455KHz
100KHz

TRANSMITTER SECTION

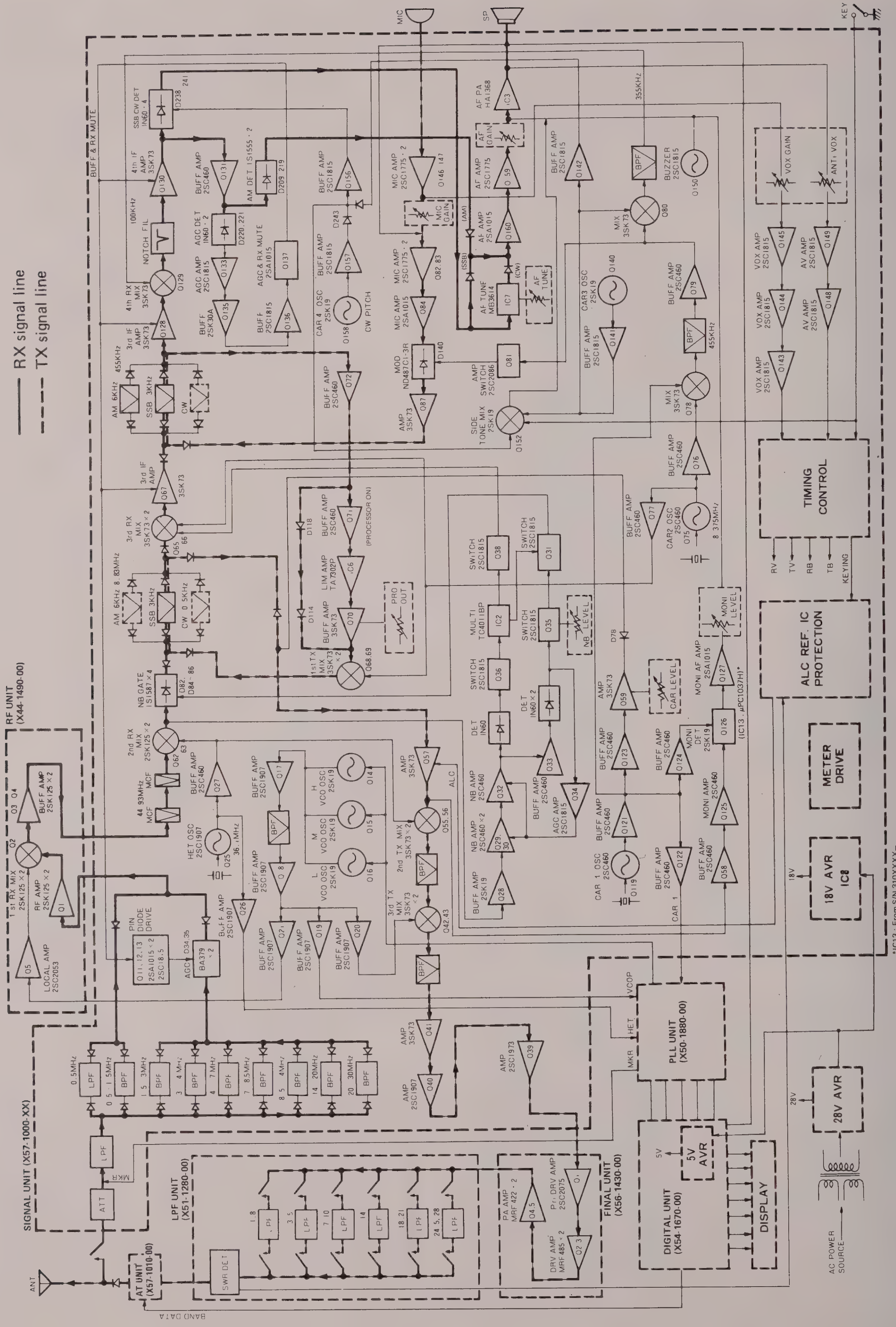

SIGNAL UNIT(X57-1000-11)
1.5KHz
20mV
.26V
4.6mV
.01V
.17V
.16V
.044V
.048V
.06V
.04V
.03V
.04V
.032V
.03V
.022V
1.8V
MIC
Q147
Q146
C566
C399
MOD
L152
Q81
CAR 455KHz
1.1V
Q87
AMP
L153
D133
D128
CF1
D131
Q72
Q71
L136
PROC
D111
C339
D118
D114
L134
Q68
Q69
1st MIX
L133
CAR2 8.375MHz
.2V
XF3
D95 D93
D88 D81
L112
Q57
IF AMP
L111


SIGNAL UNIT(X57-1000-11)
FINAL UNIT(X56-1430-00)
.06V
.2V
.028V
.068V
.06V
.78V
.95V
1.2V
(1.26V)
(3Vpp)
.6V
1.2V
.9V
5.2V
80V
70V
L111
L99
Q55
Q56
2nd MIX
HET 36.1MHz
.2V
L97
~
L94
Q42
Q43
3rd MIX
VCO
1.1V
L91
L89
Q41
Q40
Q39
DRV
50Ω
IN
Q1
T2
Q2
Q3
T3
Q4
Q5
T4
OUT
LPF
AT
ANT
50Ω

FREQUENCY : 14.200MHz
MIC INPUT : 20mV 1.5kHz

( ) : Adjust MIC input level so that the voltage at the 50Ω dummy is 3Vpp (1.26Vrms).

TS-930S BLOCK DIAGRAM


RX signal line
TX signal line
MIC
SP
KEY
BUFF & RX MUTE
SSB CW DET 1N60 × 4
Q238 241
4th IF AMP 3SK73
Q130
BUFF AMP 2SC460
Q131
AM DET 1S1555 × 2
D209 219
BUFF AMP 2SC1815
Q156
MIC AMP 2SC1775 × 2
Q146 147
AF PA HA1368
IC3
AF GAIN
AF AMP 2SC1775
Q159
BUFF AMP 2SC1815
Q142
355KHz
BPF
BUZZER 2SC1815
Q150
VOX GAIN
ANTI VOX
100KHz
NOTCH FIL
AGC DET 1N60 × 2
D220 221
AGC & RX MUTE 2SA1015
Q137
D243
MIC GAIN
(AM)
(SSB)
(CW)
AF AMP 2SA1015
Q160
MIX 3SK73
Q80
VOX AMP 2SC1815
Q145
AV AMP 2SC1815
Q149
4th RX MIX 3SK73
Q129
AGC AMP 2SC1815
Q133
BUFF 2SK30A
Q135
BUFF 2SC1815
Q136
BUFF AMP 2SC1815
Q157
CAR 4 OSC 2SK19
Q158
CW PITCH
MIC AMP 2SC1775 × 2
Q82 83
AF TUNE MB3614
IC7
AF TUNE
CAR3 OSC 2SK19
Q140
BUFF AMP 2SC460
Q79
VOX AMP 2SC1815
Q144
AV AMP 2SC1815
Q148
3rd IF AMP 3SK73
Q128
455KHz
AM 6KHz
SSB 3KHz
CW
MIC AMP 2SA1015
Q84
MOD ND487C1-3R
D140
AMP SWITCH 2SC2086
Q81
BUFF AMP 2SC460
Q141
BPF
455KHz
BUFF AMP 2SC460
Q72
AMP 3SK73
Q87
SIDE TONE MIX 2SK19
Q152
MIX 3SK73
Q78
VOX AMP 2SC1815
Q143
3rd IF AMP 3SK73
Q67
BUFF AMP 2SC460
Q76
TIMING CONTROL
3rd RX MIX 3SK73 × 2
Q65 66
BUFF AMP 2SC460
Q71
(PROCESSOR ON)
D118
BUFF AMP 2SC460
Q77
CAR2 OSC 2SC460
Q75
8.375MHz
SWITCH 2SC1815
Q38
SWITCH 2SC1815
Q31
RV
TV
RB
TB
KEYING
AM 6KHz
8.83MHz
SSB 3KHz
CW 0.5KHz
LIM AMP TA7302P
IC6
MULTI TC4011BP
IC2
PRO OUT
BUFF AMP 3SK73
Q70
D114
SWITCH 2SC1815
Q35
NB LEVEL
MONI LEVEL
ALC REF. IC PROTECTION
NB GATE 1S1587 × 4
D82, D84~86
1st TX MIX 3SK73 × 2
Q68.69
SWITCH 2SC1815
Q36
DET 1N60 × 2
D78
AMP 3SK73
Q59
CAR LEVEL
MONI AF AMP 2SA1015
Q127
RF UNIT (X44-1490-00)
2nd RX MIX 2SK125 × 2
Q62 63
DET 1N60
AMP 3SK73
Q57
ALC
Q33
MONI DET 2SK19
Q126
(IC13 : µPC1037H)*
METER DRIVE
Q3 Q4
BUFF AMP 2SK125 × 2
BUFF AMP 2SC460
Q27
44.93MHz
MCF
MCF
BUFF AMP 2SC1907
Q17
H VCO OSC 2SK19
Q14
NB AMP 2SC460
Q32
BUFF AMP 2SC460
Q123
BUFF AMP 2SC460
Q124
AGC AMP 2SC1815
Q34
M VCO OSC 2SK19
Q15
2nd TX MIX 3SK73 × 2
Q55.56
1st RX MIX 2SK125 × 2
Q2
RF AMP 2SK125 × 2
Q1
HET OSC 2SC1907
Q25
36.1MHz
BUFF AMP 2SC1907
Q8
BPF
L VCO OSC 2SK19
Q16
NB AMP 2SC460 × 2
Q29.30
BUFF AMP 2SC460
Q121
MONI AMP 2SC460
Q125
18V AVR IC8
18V
BUFF AMP 2SK19
Q28
CAR 1 OSC 2SC460
Q119
BUFF AMP 2SC460
Q122
CAR 1
BUFF AMP 2SC460
Q58
LOCAL AMP 2SC2053
Q5
PIN DIODE DRIVE
Q11,12,13 2SA1015 × 2 2SC1815
AGC
D34 35
BA379 × 2
BUFF AMP 2SC1907
Q26
BUFF AMP 2SC1907
Q21
BUFF AMP 2SC1907
Q19
BUFF AMP 2SC1907
Q20
3rd TX MIX 3SK73 × 2
Q42.43
BPF
BPF
*IC13 : From S/N 310XXXX–
VCOP
HET
MKR
PLL UNIT (X50-1880-00)
AMP 3SK73
Q41
AMP 2SC1973
Q39
AMP 2SC1907
Q40
0.5MHz LPF
0.5~1.5MHz BPF
1.5~3MHz BPF
3~4MHz BPF
4~7MHz BPF
7~8.5MHz BPF
8.5~14MHz BPF
14~20MHz BPF
20~30MHz BPF
LPF
MKR
ATT
SIGNAL UNIT (X57-1000-XX)
LPF UNIT (X51-1280-00)
1.8 LPF
3.5 LPF
7 10 LPF
14 LPF
18 21 LPF
24.5 28 LPF
SWR DET
AT UNIT (X57-1010-00)
ANT
PA AMP MRF422 × 2
Q4.5
Pre DRV AMP 2SC2075
Q1
DRV AMP MRF485 × 2
Q2 3
FINAL UNIT (X56-1430-00)
DIGITAL UNIT (X54-1670-00)
5V AVR
5V
DISPLAY
28V
28V AVR
AC POWER SOURCE
BAND DATA

SP-930

SP-930 SPECIFICATIONS

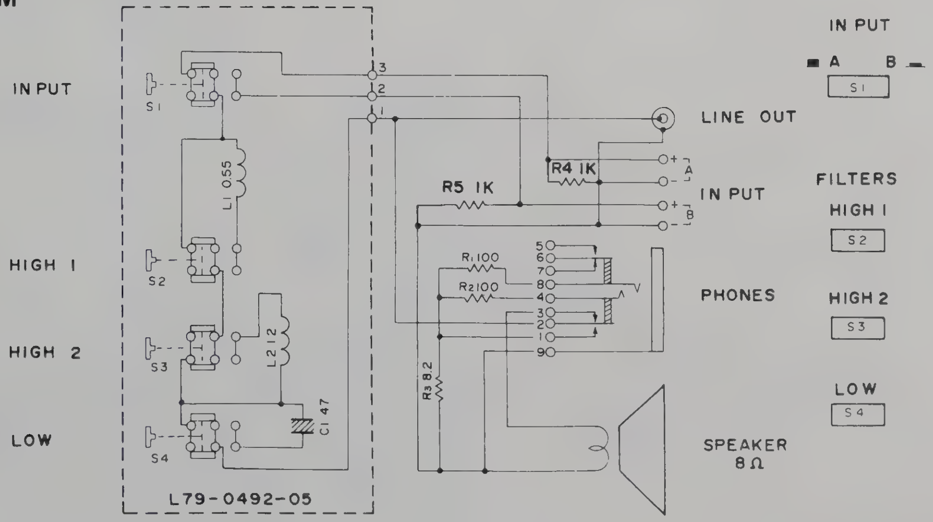
Speaker used:	10 cm dia.
Rated Input:	1.5 Watts
Impedance:	8Ω
Frequency response:	160 Hz to 8kHz.
Filter cut-off frequency,	
LOW:	430Hz, –3dB.
HIGH 1:	2.3 kHz, –3dB.
HIGH 2:	1.0kHz, –3dB.
HIGH 1 + HIGH 2:	730Hz, –3dB.
Filter attenuation:	–6dB/oct.
Dimensions:	W 180 mm (7-1/16") H 140 mm (5-1/2") D 288 mm (11-1/3")
Net weight:	1.9 kg. (4.2 lbs.)
Accessories furnished:	Speaker cord, 1 pc. (E14-0101-05) 1 pin plug, 2 pcs. (E20-1610-05)

PARTS LIST

N : New parts

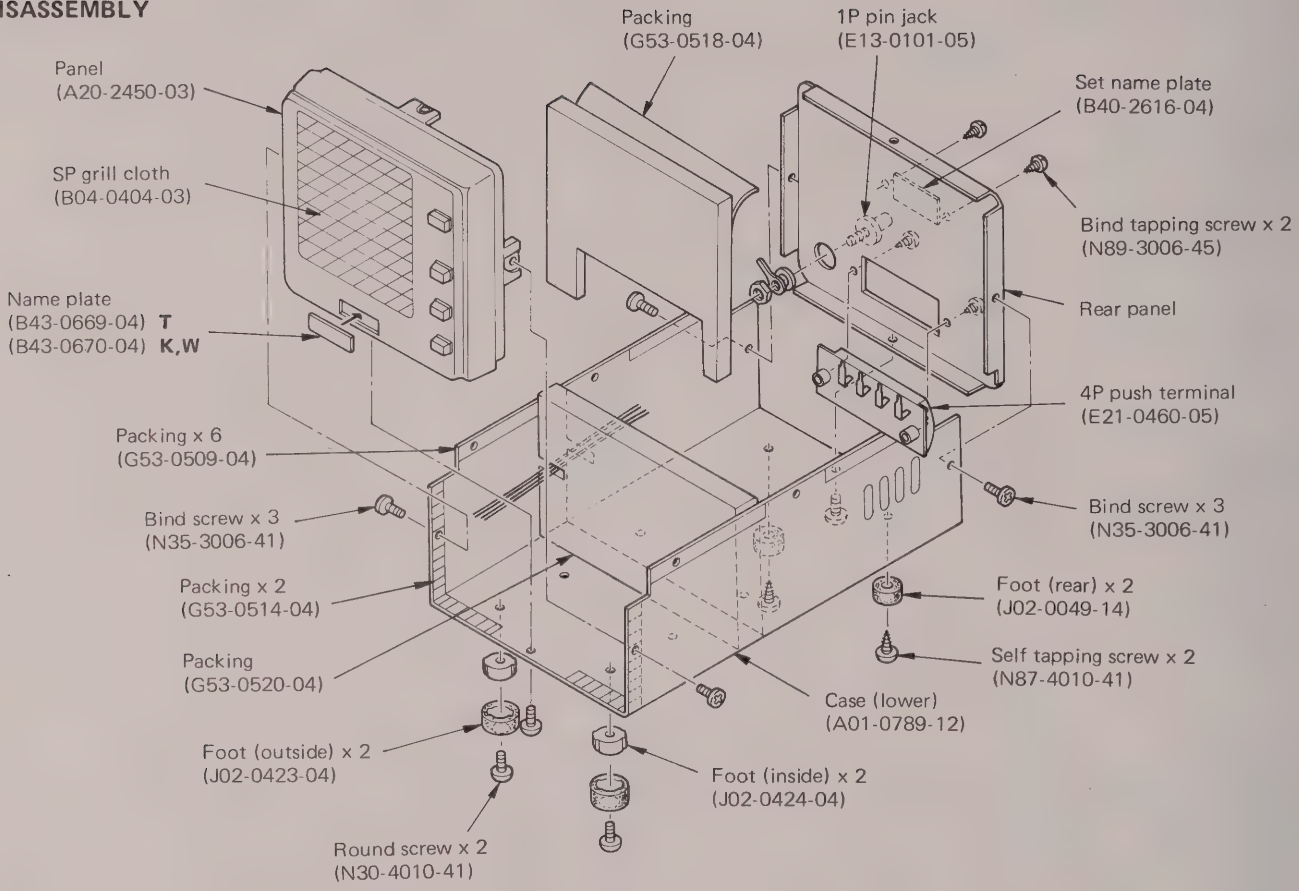
Parts No.	Re-marks	Description	Ref. No.
A01-0789-12		Case (lower)	
A01-0928-03	N	Case (upper)	
A20-2450-03	N	Panel	
B04-0404-03	N	SP grill cloth	
B40-2616-04	N	Set name plate	
B43-0669-04		Name plate **T**	
B43-0670-04		Name plate **K,W**	
B46-0404-00	N	Warranty card **K**	
B50-3980-00	N	Instruction manual **K,W**	
B50-3981-00	N	Instruction manual **T**	
CE04BW1E470		E 47 25V	
E11-0404-05		Headphone jack	
E13-0101-05		1P pin jack	
E14-0101-05		1P pin plug Accessory	
E21-0460-05	N	4P push terminal	
E30-1711-15	N	SP cord Accessory	
E40-0373-05		Mini connect wafer 3P	
G53-0509-04		Packing x 6	
G53-0514-04		Packing x 2	
G53-0517-04	N	Packing x 8	
G53-0518-04	N	Packing	
G53-0520-04	N	Packing	
H01-4426-04	N	Packing carton (inside) **K,W**	
H01-4427-04	N	Packing carton (inside) **T**	
H12-0500-03	N	Cushion x 2	
H20-0276-03		Protective cover	
H25-0049-03		Protective bag	
J02-0049-14		Foot (rear) x 2	
J02-0423-04		Foot (outside) x 2	
J02-0424-04		Foot (inside) x 2	
J61-0019-05		Vinyle tie x 3	
K29-0757-04		Push knob A,B	
K29-0758-04		Push knob x 3	
L79-0492-05		Filter ass'y	
N30-4010-46		Round screw x 2	
N35-3006-41		Bind screw x 14	
N87-3008-41		Self tapping screw x 4	
N87-4008-46		Self tapping screw x 4	
N87-4010-41		Self tapping screw x 2	
N89-3006-45		Bind tapping screw x 2	
N89-3008-45		Bind tapping screw x 2	
RS14AB3D8R2J		MF 8.2Ω 2W	R3
S40-2436-05		Push switch	
S42-3405-05		Push switch	
T07-0222-05	N	Speaker	

SCHEMATIC DIAGRAM

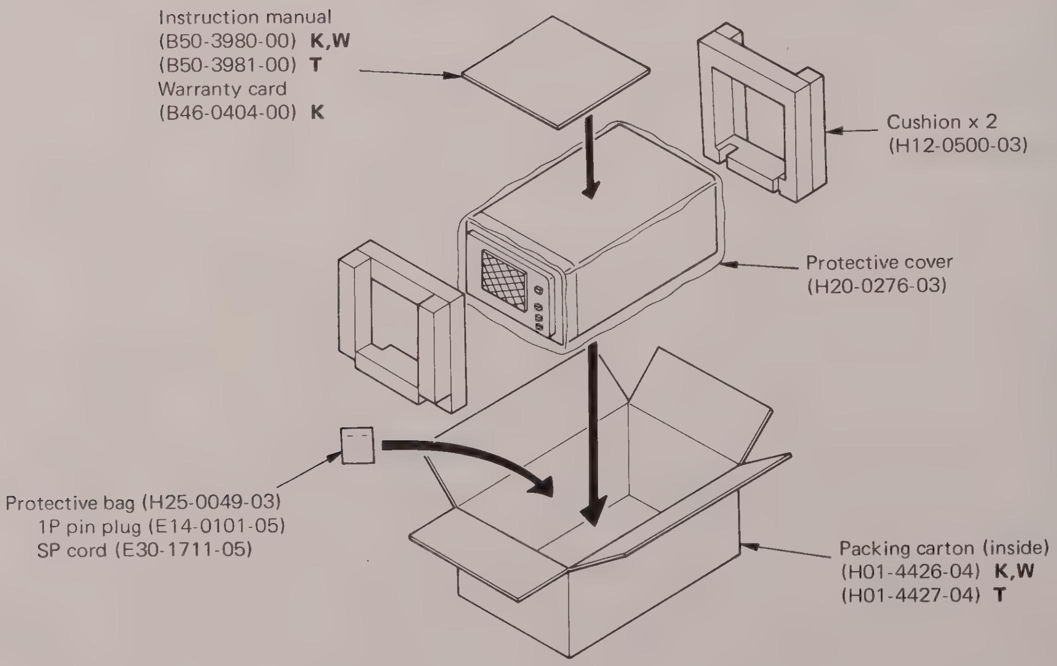


SP-930

DISASSEMBLY


Panel
(A20-2450-03)
SP grill cloth
(B04-0404-03)
Name plate
(B43-0669-04) **T**
(B43-0670-04) **K,W**
Packing x 6
(G53-0509-04)
Bind screw x 3
(N35-3006-41)
Packing x 2
(G53-0514-04)
Packing
(G53-0520-04)
Foot (outside) x 2
(J02-0423-04)
Round screw x 2
(N30-4010-41)
Foot (inside) x 2
(J02-0424-04)
Packing
(G53-0518-04)
1P pin jack
(E13-0101-05)
Set name plate
(B40-2616-04)
Bind tapping screw x 2
(N89-3006-45)
Rear panel
4P push terminal
(E21-0460-05)
Bind screw x 3
(N35-3006-41)
Foot (rear) x 2
(J02-0049-14)
Self tapping screw x 2
(N87-4010-41)
Case (lower)
(A01-0789-12)

PACKING


Instruction manual
(B50-3980-00) **K,W**
(B50-3981-00) **T**
Warranty card
(B46-0404-00) **K**
Cushion x 2
(H12-0500-03)
Protective cover
(H20-0276-03)
Protective bag (H25-0049-03)
1P pin plug (E14-0101-05)
SP cord (E30-1711-05)
Packing carton (inside)
(H01-4426-04) **K,W**
(H01-4427-04) **T**

AT-930

AT-930 SPECIFICATIONS

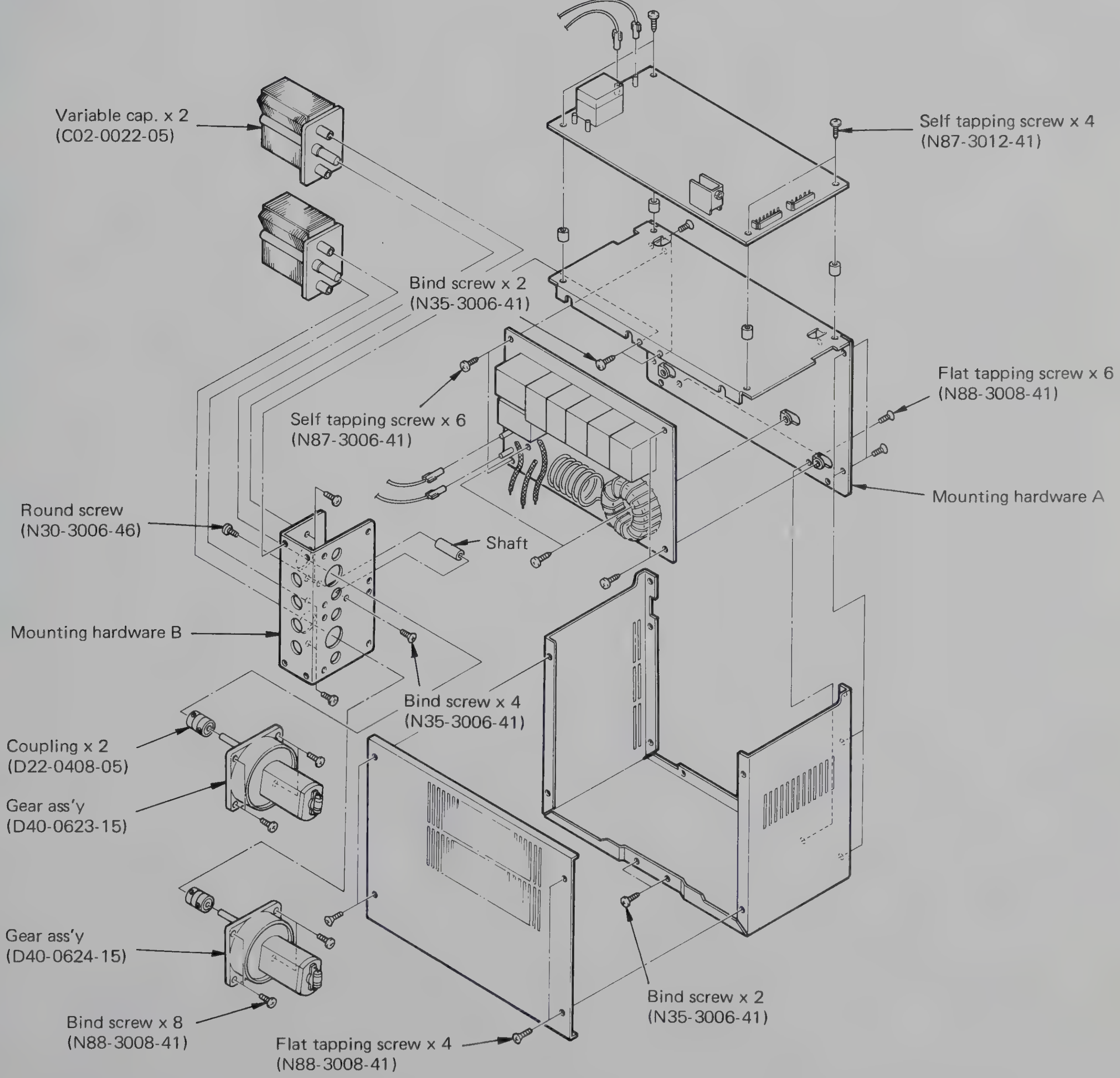
Frequency range:	3.5–29.7 MHz, all amateur bands
Band Selection:	Automatic, by band information from the transceiver.
Input impedance:	50 ohms, unbalanced
Output impedance:	20–150 ohms, unbalanced
Insertion loss:	Less than 1 dB at 29.7 MHz (at best match)
Max. input power:	150W
Motor stop SWR:	Less than 1.2

PARTS LIST

N : New parts

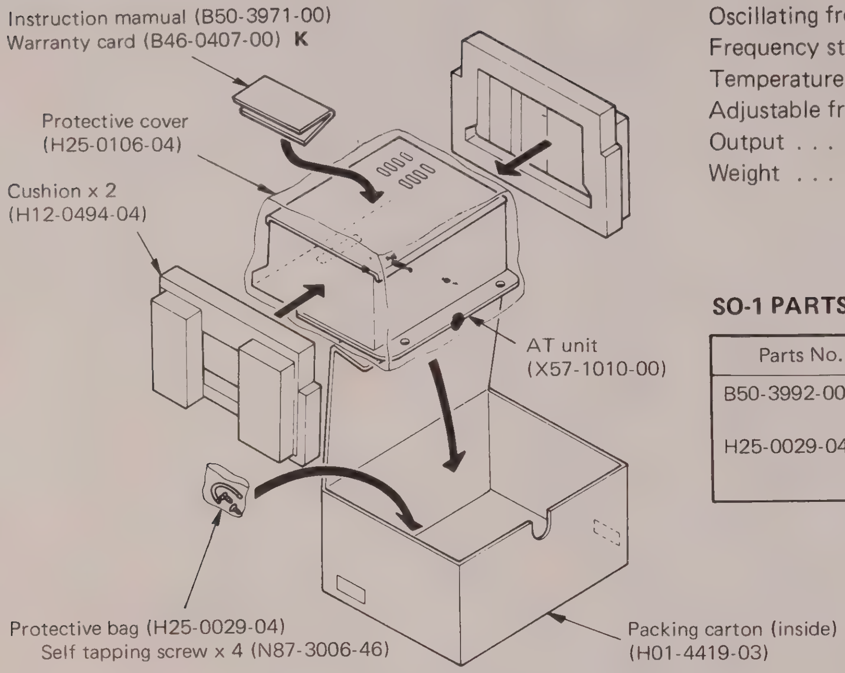
Parts No.	Re-marks	Description	Ref. No.
B46-0407-00	N	Warranty card K	
B50-3971-00	N	Instruction manual	
H01-4419-03	N	Packing carton (inside)	
H12-0494-04	N	Cushion x 2	
H25-0029-04		Protective bag Accessory	
H25-0106-04		Protective cover	
N87-3006-46		Self tapping screw x 4	
X57-1010-00	N	AT unit	

DISASSEMBLY


Variable cap. x 2
(C02-0022-05)
Self tapping screw x 4
(N87-3012-41)
Bind screw x 2
(N35-3006-41)
Flat tapping screw x 6
(N88-3008-41)
Self tapping screw x 6
(N87-3006-41)
Mounting hardware A
Round screw
(N30-3006-46)
Shaft
Mounting hardware B
Bind screw x 4
(N35-3006-41)
Coupling x 2
(D22-0408-05)
Gear ass'y
(D40-0623-15)
Gear ass'y
(D40-0624-15)
Bind screw x 2
(N35-3006-41)
Bind screw x 8
(N88-3008-41)
Flat tapping screw x 4
(N88-3008-41)

AT-930/SO-1

AT-930 PACKING


Instruction manual (B50-3971-00)
Warranty card (B46-0407-00) K
Protective cover (H25-0106-04)
Cushion x 2 (H12-0494-04)
AT unit (X57-1010-00)
Protective bag (H25-0029-04)
Self tapping screw x 4 (N87-3006-46)
Packing carton (inside) (H01-4419-03)

SO-1 SPECIFICATIONS

Oscillating frequency	20MHz
Frequency stability (long period)	±1 x 10^{-6}/Year
Temperature stability	±5 x 10^{-7} (–10°C ~ +50°C)
Adjustable frequency range	More than ± 60Hz
Output	More than 0dBm at 50Ω
Weight	25g

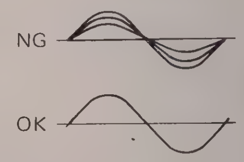
SO-1 PARTS LIST

N : New parts

Parts No.	Re-marks	Description	Ref. No.
B50-3992-00	N	Instruction manual	
H25-0029-04		Protective bag	

SO-1 ADJUSTMENT

Required f-counter frequency stability (ageing rate) : Better than 2 x 10^{-8}/day
The f-counter must be preheated enough before use.

Item	Condition	Measurement			Adjustment			Specification/Remarks
		Test equipment	Unit	Terminal	Unit	Part	Method	
Reference frequency oscillotor	1) FREQ : 10,000.0kHz MODE : USB CAL : ON Connect reference signal output of the f-counter to ANT terminal.	f. counter Osillo-scope SP	Rear panel	ANT EXT.SP	SO-1 (PLL)	Poten-tiome-ter	Receive reference signal and marker signal, then adjust so that the AF audio signal becomes the same tone.	Oscilloscope wave  NG OK

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KENWOOD U.S.A. CORPORATION
COMMUNICATIONS & TEST EQUIPMENT GROUP
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KENWOOD & LEE ELECTRONICS, LTD.
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KENWOOD ELECTRONICS CANADA INC.
P.O. BOX 1075, 959 Gana Court, Mississauga, Ontario, Canada L5S 1N9

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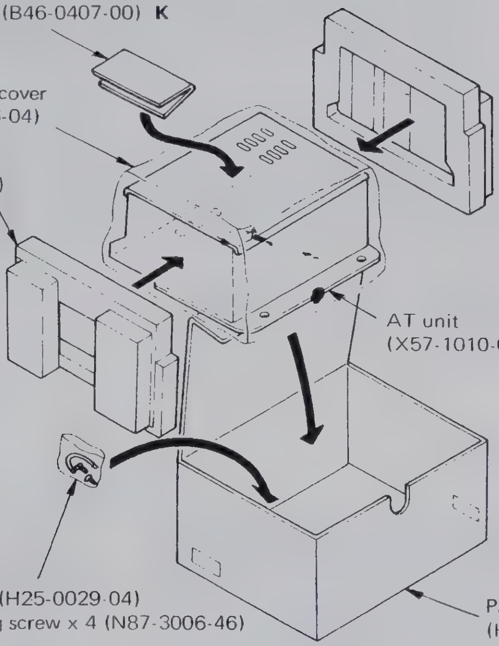
AT-930/SO-1

AT-930 PACKING


Instruction manual (B50-3971-00)
Warranty card (B46-0407-00) **K**
Protective cover
(H25-0106-04)
Cushion x 2
(H12-0494-04)
AT unit
(X57-1010-00)
Protective bag (H25-0029-04)
Self tapping screw x 4 (N87-3006-46)
Packing carton (inside)
(H01-4419-03)

SO-1 SPECIFICATIONS

Oscillating frequency 20MHz
Frequency stability (long period) . . . . . . ±1 x 10^{-6}/Year
Temperature stability . . . . . ±5 x 10^{-7} (−10°C ~ +50°C)
Adjustable frequency range . . . . More than ±60Hz
Output . . . . More than 0dBm at 50Ω
Weight 25g

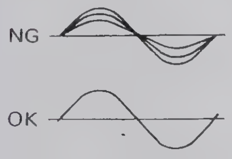
SO-1 PARTS LIST

N : New parts

Parts No.	Re marks	Description	Ref. No.
B50-3992-00	N	Instruction manual	
H25-0029-04		Protective bag	

SO-1 ADJUSTMENT

Required f-counter frequency stability (ageing rate) : Better than 2 x 10^{-8}/day
The f-counter must be preheated enough before use.

Item	Condition	Measurement			Adjustment			Specification/Remarks
		Test equipment	Unit	Terminal	Unit	Part	Method	
Reference frequency oscillotor	1) FREQ : 10,000.0kHz MODE : USB CAL : ON Connect reference signal output of the f-counter to ANT terminal.	f. counter Osillo-scope SP	Rear panel	ANT EXT.SP	SO-1 (PLL)	Poten-tiome-ter	Receive reference signal and marker signal, then adjust so that the AF audio signal becomes the same tone.	Oscilloscope wave  NG OK

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AT-930

AT-930 SPECIFICATIONS

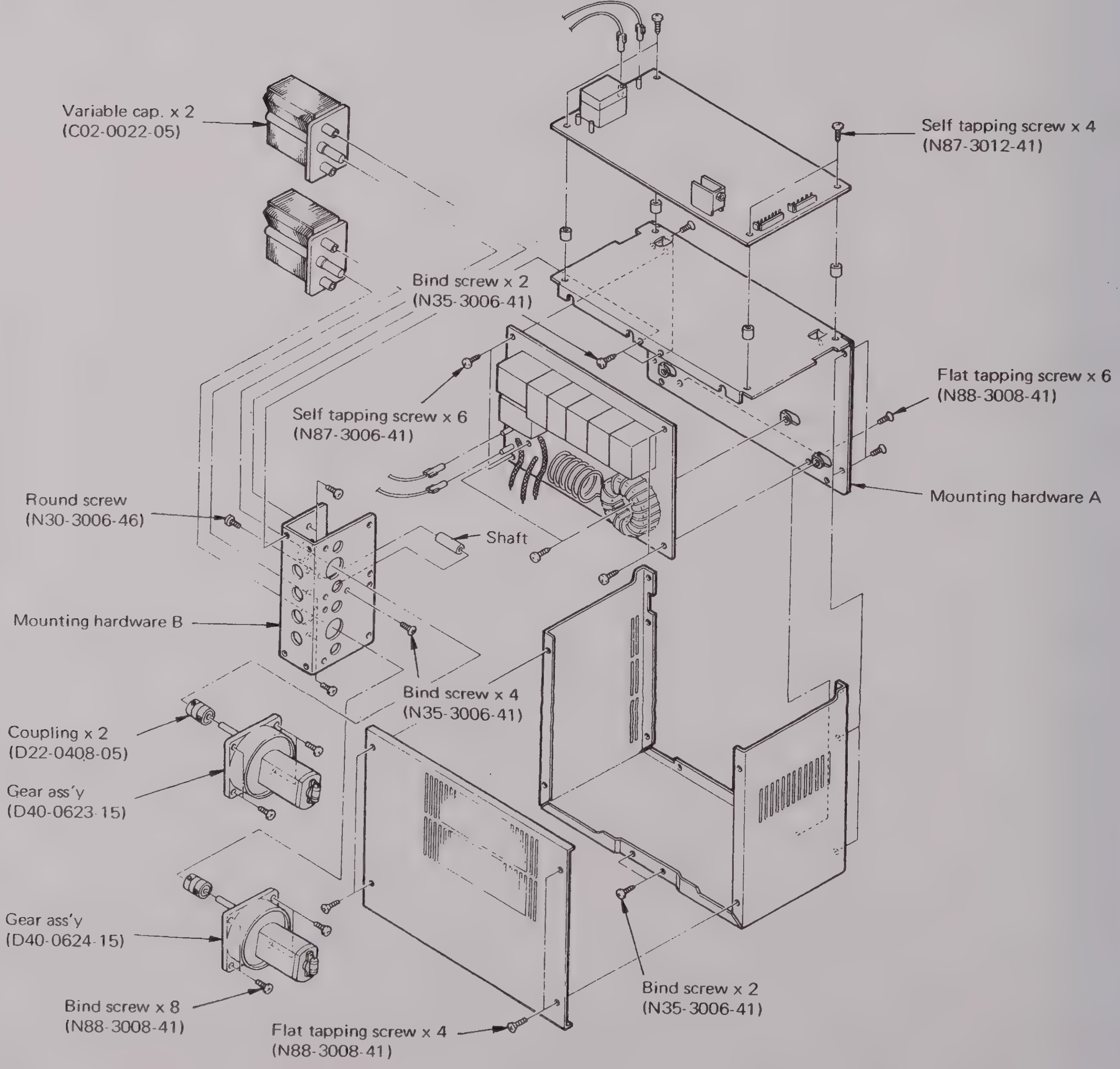
Frequency range:	3.5—29.7 MHz, all amateur bands
Band Selection:	Automatic, by band information from the transceiver.
Input impedance:	50 ohms, unbalanced
Output impedance:	20—150 ohms, unbalanced
Insertion loss:	Less than 1 dB at 29.7 MHz (at best match)
Max. input power:	150W
Motor stop SWR:	Less than 1.2

PARTS LIST

N : New parts

Parts No.	Re-marks	Description	Ref. No.
B46-0407-00	N	Warranty card K	
B50-3971-00	N	Instruction manual	
H01-4419-03	N	Packing carton (inside)	
H12-0494-04	N	Cushion x 2	
H25-0029-04		Protective bag Accessory	
H25-0106-04		Protective cover	
N87-3006-46		Self tapping screw x 4	
X57-1010-00	N	AT unit	

DISASSEMBLY



Variable cap. x 2
(C02-0022-05)
Self tapping screw x 4
(N87-3012-41)
Bind screw x 2
(N35-3006-41)
Flat tapping screw x 6
(N88-3008-41)
Self tapping screw x 6
(N87-3006-41)
Mounting hardware A
Round screw
(N30-3006-46)
Shaft
Mounting hardware B
Bind screw x 4
(N35-3006-41)
Coupling x 2
(D22-0408-05)
Gear ass'y
(D40-0623-15)
Gear ass'y
(D40-0624-15)
Bind screw x 8
(N88-3008-41)
Flat tapping screw x 4
(N88-3008-41)
Bind screw x 2
(N35-3006-41)

KENWOOD

SERVICE MANUAL

TS-930S SP-930, AT-930, SO-1

HF TRANSCEIVER

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INTERCONNECT &
SIGNAL UNIT SCHEMATIC .... INSERT

SPECIFICATIONS

[GENERAL]

Transmitter Frequency Range:	160 m Band 1.8 ~ 2.0 MHz 80 m Band 3.5 ~ 4.0 MHz 40 m Band 7.0 ~ 7.3 MHz *30 m Band 10.1 ~ 10.15 MHz (10.0 MHz WWV) 20 m Band 14.0 ~ 14.35 MHz *17 m Band 18.068 ~ 18.168 MHz 15 m Band 21.0 ~ 21.45 MHz *12 m Band 24.89 ~ 24.99 MHz 10 m Band 28.0 ~ 29.7 MHz
Receiver Frequency Range:	150 kHz - 30 MHz
Mode:	A3J (USB, LSB), A1 (CW), F1 (FSK), A3 (AM)
Antenna Impedance:	50 ohms
With AT-930 antenna tuner	20 - 150 ohms (80 - 10 meter Amateur bands only)
Power Requirement:	120/220/240 VAC, 50/60 Hz
Power Dissipation:	Max. 510 W during transmission, 80 W during reception
Dimensions:	374(14-3/4")W × 141 (5-9/16")H × 350(13-13/16")D mm (inches)
Weight:	With antenna tuner: Approx. 18.5 kg (40.8 lbs) Without antenna tuner: Approx. 16.8 kg (37.0 lbs)

[TRANSMITTER]

Final Power Input:	SSB/CW/FSK 250 W AM 80 W
Carrier Suppression:	Better than 40 dB
Unwanted Sideband Suppression:	Better than 50 dB (with 1 kHz modulation)
Harmonic Content:	Less than −40 dB
Audio Frequency Response:	400 - 2,600 Hz/−6 dB
Modulation:	SSB: Balanced modulation AM: Low level modulation (IF stage)
FSK Shift:	170 Hz
Modulation Distortion:	Less than −31 dB
Microphone Impedance:	500 ohms or 50 kohms (Connector - switchable)
ALC Input:	−10 V DC MAX
Linear Amplifier Switching:	200 V DC MAX 100 mA

[RECEIVER]

Circuitry:	Quadruple conversion
Intermediate Frequencies:	1st IF: 44.93 MHz 2nd IF: 8.83 MHz 3rd IF: 455 kHz 4th IF: 100 kHz
Sensitivity (at 10 dB S+N/N)	
150 - 500 kHz:	Less than 1 μV for SSB, CW and FSK Less than 10 μV for AM
500 kHz - 1.8 MHz:	Less than 4 μV for SSB, CW and FSK Less than 32 μV for AM
1.8 - 30 MHz:	Less than 0.25 μV for SSB, CW and FSK Less than 2 μV for AM
Image Ratio:	More than 80 dB (1.8 MHz ~ 30 MHz)
IF Rejection:	More than 70 dB (1.8 MHz ~ 30 MHz)

Selectivity (W-wide, N-narrow filter selection)	
SSB, CW(W), FSK(W), AM(N):	2.7 kHz/−6 dB, 4.0 kHz/−60 dB
CW(N), FSK(N):	Without optional filter: same as CW(W), FSK(W) With optional YG-455C-1: 500 Hz/−6 dB, 820 Hz/−60 dB With optional YG-455CN-1: 250 Hz/−6 dB, 480 Hz/−60 dB With optional YK-88C-1: 500 Hz/−6 dB, 1.5 kHz/−60 dB
AM(W):	Without optional filter: 6 kHz/−6 dB, 18 kHz/−60 dB With optional YK-88A-1: 6 kHz/−6 dB, 11 kHz/−60 dB
SSB Slope Tune:	High-cut: More than 1500 Hz shift/−6 dB Low-cut: More than 700 Hz shift/−6 dB
CW VBT	
CW(W), FSK(W) AM(N):	600 Hz ~ 2.7 kHz/−6 dB
CW(N), FSK(N):	Without optional filter: same as CW(W), FSK(W) With optional YK-88C-1 and YG-455C-1 installed: 150 Hz ~ 500 Hz −6 dB
AM(W):	With optional YK-88A-1: 4 kHz ~ 6 kHz/−6 dB
Frequency Stability:	Within ±200 Hz after turn-on Within ±30 Hz any 30 minute period there after at constant temperature
Frequency Accuracy:	±1 × 10⁻⁵ or better (at normal temperatures)
RIT Variable Range:	±9.99 kHz
Notch Filter Attenuation:	More than 40 dB
Phone Patch Output Z:	600 Ω
Audio Output Power:	More than 1.5 W across 8 Ω (at 10% distortion)

AT-930 (Automatic Antenna Tuner)

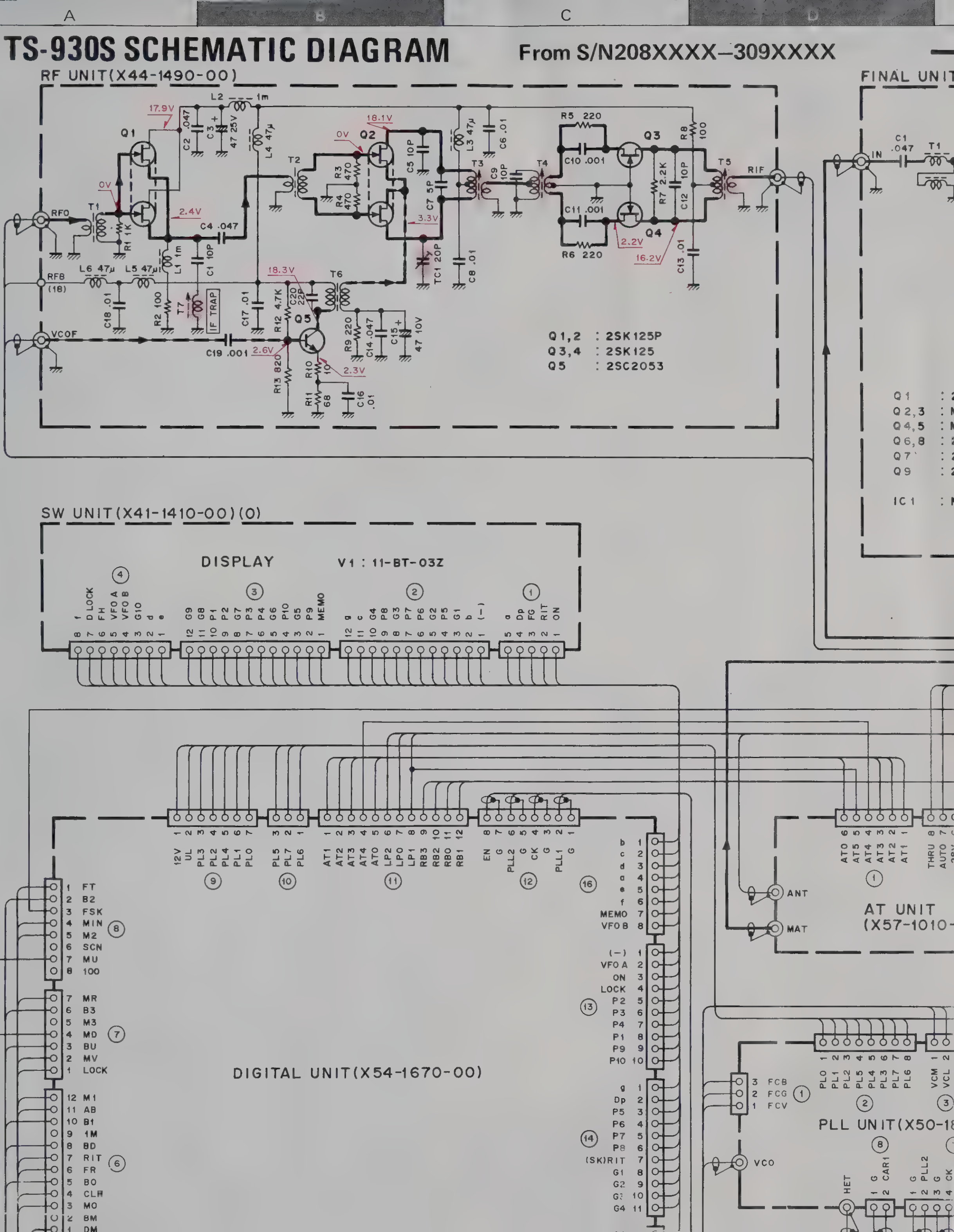
Frequency Range:	Amateur bands from 80 ~ 10 m
Input Impedance:	50 Ω, unbalanced
Output Impedance:	20 ~ 150 Ω unbalanced
Insertion Loss:	Less than 1 dB at 3.5 MHz (at optimum match)
Through Power:	150 W max.
Motor Stop SWR Value:	Less than 1.2

*Will transmit on the new 30, 17, and 12 meter bands. Lock-out circuitry installed to prevent accidental transmission before government amateur authorization.

NOTE: The circuit and ratings may change without notice due to developments in technology.

TS-930S SCHEMATIC DIAGRAM

From S/N208XXXX–309XXXX



A
B
C
D
RF UNIT(X44-1490-00)
FINAL UNIT
Q1
Q2
Q3
Q4
Q5
17.9V
0V
2.4V
18.1V
3.3V
18.3V
2.6V
2.3V
2.2V
16.2V
L2 1m
C2 .047
C3 47 25V
L4 47μ
T2
R3 470
R4 470
C5 10P
C7 5P
TC1 20P
L3 47μ
C6 .01
C8 .01
T3
C9 10P
T4
R5 220
C10 .001
C11 .001
R6 220
R8 100
R7 2.2K
C12 10P
C13 .01
T5
RIF
RFO
T1
R1 1K
C4 .047
L1 1m
C1 10P
RFB (18)
L6 47μ
L5 47μ
C18 .01
R2 100
T7
IF TRAP
C17 .01
R12 4.7K
C20 22P
T6
R9 220
C14 .047
C15 47 10V
VCOF
C19 .001
R13 820
R10 10
R11 68
C16 .01
Q1,2 : 2SK125P
Q3,4 : 2SK125
Q5 : 2SC2053
IN
C1 .047
SW UNIT(X41-1410-00)(0)
DISPLAY
V1 : 11-BT-03Z
④ f D LOCK FH VFO A VFO B G10 d e
③ G9 G8 P1 P2 G7 P3 P4 G6 P10 G5 P9 MEMO
② g c G4 P8 G3 P7 P6 G2 P5 G1 b (−)
① a Dp FG RIT ON
⑨ 12V UL PL3 PL2 PL4 PL1 PL0
⑩ PL5 PL7 PL6
⑪ AT1 AT2 AT3 AT4 ATO LP2 LPO LP1 RB3 RB2 RB0 RB1
⑫ EN G PLL2 G CK PLL1 G
⑧ FT B2 FSK MIN M2 SCN MU 100
⑦ MR B3 M3 MD BU MV LOCK
⑥ M1 AB B1 1M BD RIT FR BO CLR MO BM DM
⑯ b c d a e f MEMO VFO B
⑬ (−) VFO A ON LOCK P2 P3 P4 P1 P9 P10
⑭ g Dp P5 P6 P7 P8 (SK)RIT G1 G2 G3 G4
DIGITAL UNIT(X54-1670-00)
ANT
MAT
AT UNIT
(X57-1010-
① ATO AT5 AT4 AT3 AT2 AT1
THRU AUTO
③ FCB FCG FCV ①
VCO
PLL UNIT(X50-18
② PLO PL1 PL2 PL5 PL4 PL3 PL7 PL6
③ VCM VCL
⑧ HET G CAR1 G PLL2 G CK

SPECIFICATIONS

[GENERAL]

Transmitter Frequency Range:	160 m Band 1.8 ~ 2.0 MHz 80 m Band 3.5 ~ 4.0 MHz 40 m Band 7.0 ~ 7.3 MHz *30 m Band 10.1 ~ 10.15 MHz (10.0 MHz WWV) 20 m Band 14.0 ~ 14.35 MHz *17 m Band 18.068 ~ 18.168 MHz 15 m Band 21.0 ~ 21.45 MHz *12 m Band 24.89 ~ 24.99 MHz 10 m Band 28.0 ~ 29.7 MHz
Receiver Frequency Range:	150 kHz - 30 MHz
Mode:	A3J (USB, LSB), A1 (CW), F1 (FSK), A3 (AM)
Antenna Impedance:	50 ohms
With AT-930 antenna tuner	20 - 150 ohms (80 - 10 meter Amateur bands only)
Power Requirement:	120/220/240 VAC, 50/60 Hz
Power Dissipation:	Max. 510 W during transmission, 80 W during reception
Dimensions:	374(14-3/4")W × 141 (5-9/16")H × 350(13-13/16")D mm (inches)
Weight:	With antenna tuner: Approx. 18.5 kg (40.8 lbs) Without antenna tuner: Approx. 16.8 kg (37.0 lbs)

[TRANSMITTER]

Final Power Input:	SSB/CW/FSK 250 W AM 80 W
Carrier Suppression:	Better than 40 dB
Unwanted Sideband Suppression:	Better than 50 dB (with 1 kHz modulation)
Harmonic Content:	Less than −40 dB
Audio Frequency Response:	400 - 2,600 Hz/−6 dB
Modulation:	SSB: Balanced modulation AM: Low level modulation (IF stage)
FSK Shift:	170 Hz
Modulation Distortion:	Less than −31 dB
Microphone Impedance:	500 ohms or 50 kohms (Connector - switchable)
ALC Input:	−10 V DC MAX
Linear Amplifier Switching:	200 V DC MAX 100 mA

[RECEIVER]

Circuitry:	Quadruple conversion
Intermediate Frequencies:	1st IF: 44.93 MHz 2nd IF: 8.83 MHz 3rd IF: 455 kHz 4th IF: 100 kHz
Sensitivity (at 10 dB S+N/N)	
150 - 500 kHz:	Less than 1 µV for SSB, CW and FSK Less than 10 µV for AM
500 kHz - 1.8 MHz:	Less than 4 µV for SSB, CW and FSK Less than 32 µV for AM
1.8 - 30 MHz:	Less than 0.25 µV for SSB, CW and FSK Less than 2 µV for AM
Image Ratio:	More than 80 dB (1.8 MHz ~ 30 MHz)
IF Rejection:	More than 70 dB (1.8 MHz ~ 30 MHz)

Selectivity (W-wide, N-narrow filter selection)	
SSB, CW(W), FSK(W), AM(N):	2.7 kHz/−6 dB, 4.0 kHz/−60 dB
CW(N), FSK(N):	Without optional filter: same as CW(W), FSK(W) With optional YG-455C-1: 500 Hz/−6 dB, 820 Hz/−60 dB With optional YG-455CN-1: 250 Hz/−6 dB, 480 Hz/−60 dB With optional YK-88C-1: 500 Hz/−6 dB, 1.5 kHz/−60 dB
AM(W):	Without optional filter: 6 kHz/−6 dB, 18 kHz/−60 dB With optional YK-88A-1: 6 kHz/−6 dB, 11 kHz/−60 dB
SSB Slope Tune:	High-cut: More than 1500 Hz shift/−6 dB Low-cut: More than 700 Hz shift/−6 dB
CW VBT	
CW(W), FSK(W) AM(N):	600 Hz ~ 2.7 kHz/−6 dB
CW(N), FSK(N):	Without optional filter: same as CW(W), FSK(W) With optional YK-88C-1 and YG-455C-1 installed: 150 Hz ~ 500 Hz −6 dB
AM(W):	With optional YK-88A-1: 4 kHz ~ 6 kHz/−6 dB
Frequency Stability:	Within ±200 Hz after turn-on Within ±30 Hz any 30 minute period there after at constant temperature
Frequency Accuracy:	$\pm 1 \times 10^{-5}$ or better (at normal temperatures)
RIT Variable Range:	±9.99 kHz
Notch Filter Attenuation:	More than 40 dB
Phone Patch Output Z:	600 Ω
Audio Output Power:	More than 1.5 W across 8 Ω (at 10% distortion)

AT-930 (Automatic Antenna Tuner)

Frequency Range:	Amateur bands from 80 ~ 10 m
Input Impedance:	50 Ω, unbalanced
Output Impedance:	20 ~ 150 Ω unbalanced
Insertion Loss:	Less than 1 dB at 3.5 MHz (at optimum match)
Through Power:	150 W max.
Motor Stop SWR Value:	Less than 1.2

*Will transmit on the new 30, 17, and 12 meter bands. Lock-out circuitry installed to prevent accidental transmission before government amateur authorization.

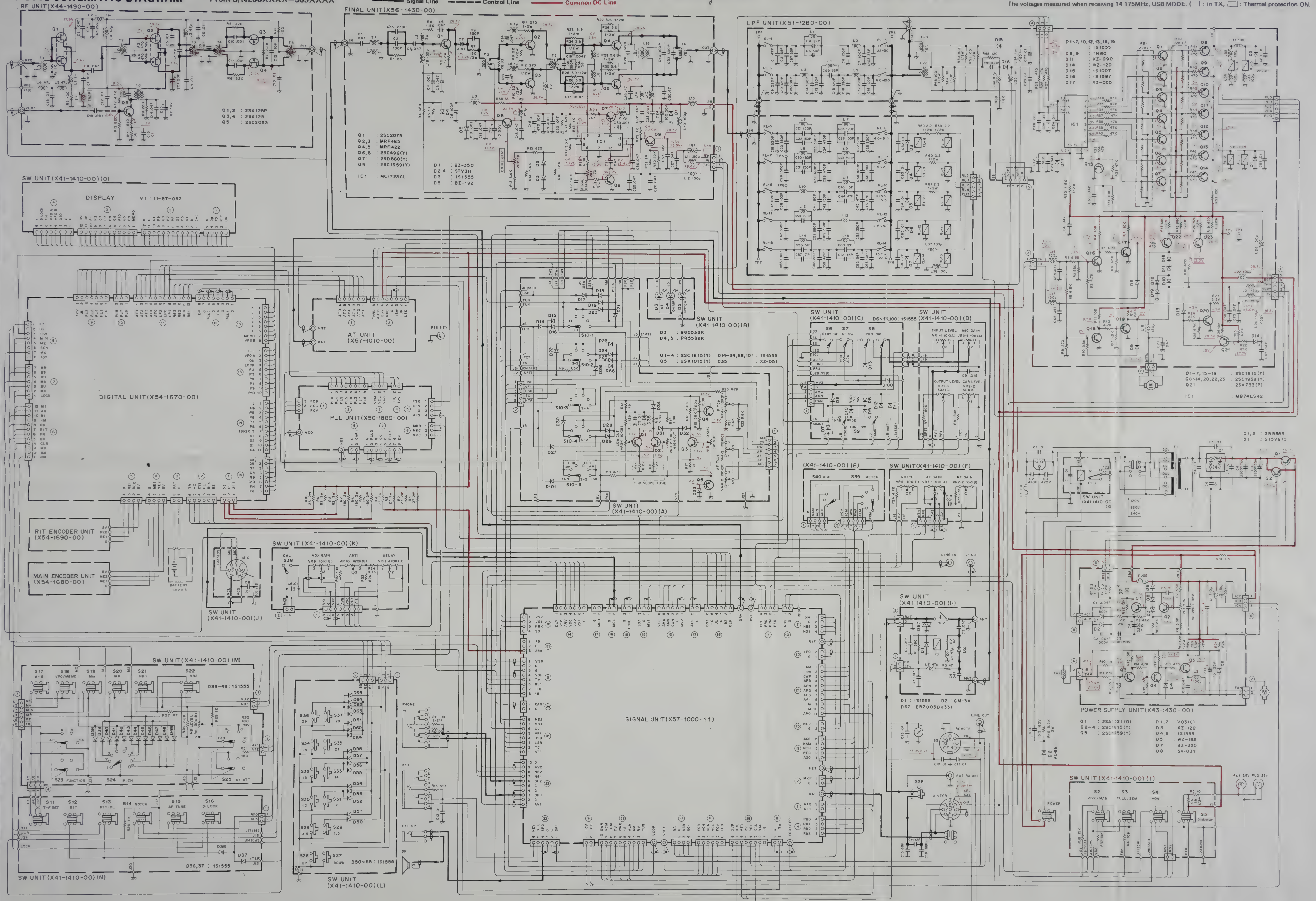
NOTE: The circuit and ratings may change without notice due to developments in technology.

TS-930S SCHEMATIC DIAGRAM

From S/N208XXXX–309XXXX

Signal Line — Control Line — Common DC Line

The voltages measured when receiving 14.175MHz, USB MODE. ( ) : in TX, [ ] : Thermal protection ON.

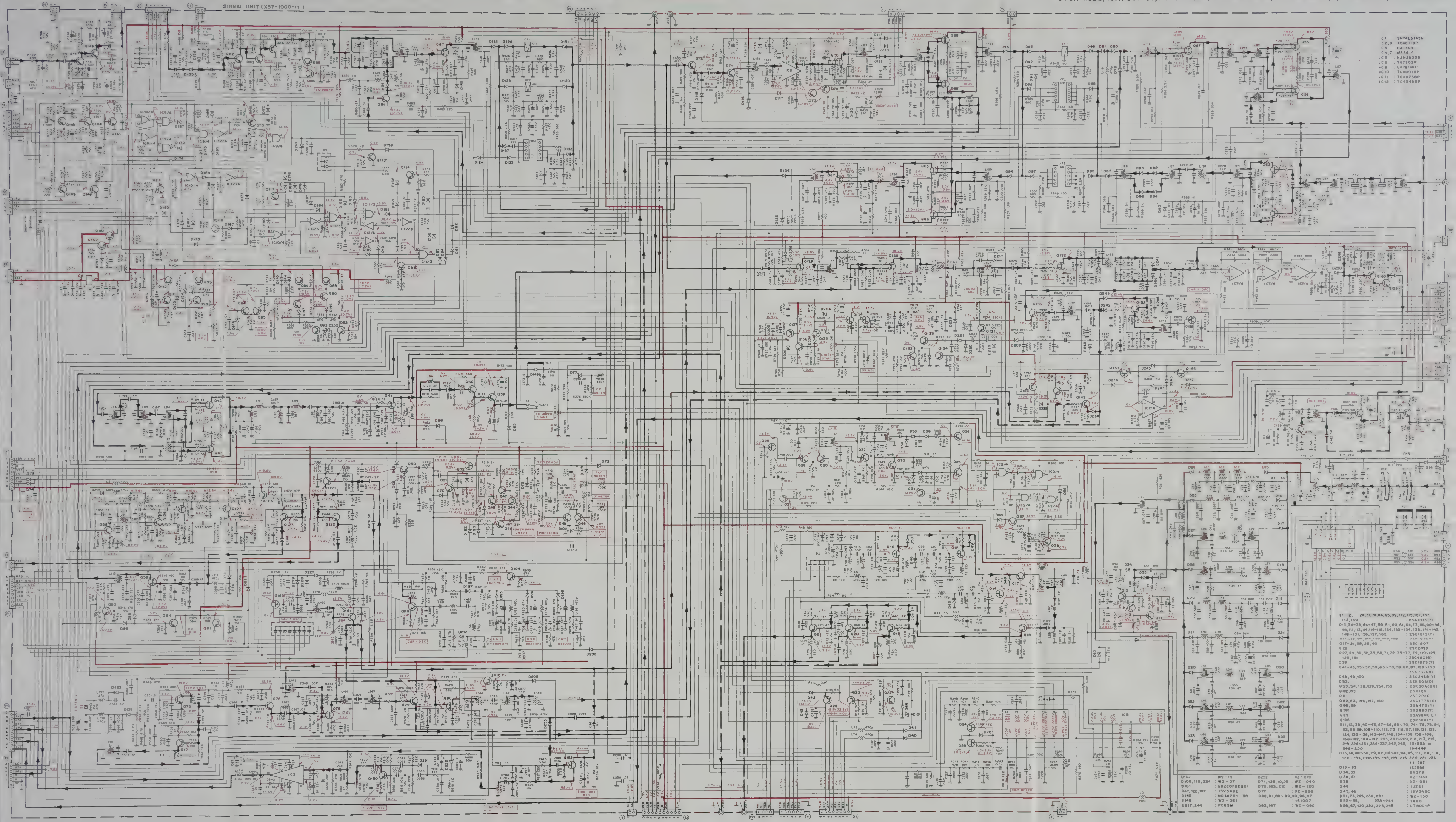

RF UNIT(X44-1490-00)
Q1,2 : 2SK125P
Q3,4 : 2SK125
Q5 : 2SC2053
FINAL UNIT(X56-1430-00)
Q1 : 2SC2075
Q2,3 : MRF485
Q4,5 : MRF422
Q6,8 : 2SC496(Y)
Q7 : 2SD880(Y)
Q9 : 2SC1959(Y)
IC1 : MC1723CL
D1 : BZ-350
D2,4 : STV3H
D3 : 1S1555
D5 : BZ-192
LPF UNIT(X51-1280-00)
D1~7,10,12,13,18,19 : 1S1555
D8,9 : 1N60
D11 : XZ-090
D14 : WZ-120
D15 : 1S1007
D16 : 1S1587
D17 : XZ-055
Q1~7,15~19 : 2SC1815(Y)
Q8~14,20,22,23 : 2SC1959(Y)
Q21 : 2SA733(P)
IC1 : MB74LS42
SW UNIT(X41-1410-00)(O)
DISPLAY
V1 : 11-BT-03Z
DIGITAL UNIT(X54-1670-00)
AT UNIT (X57-1010-00)
PLL UNIT(X50-1880-00)
SW UNIT (X41-1410-00)(B)
D3 : BG5532K
D4,5 : PR5532K
Q1~4 : 2SC1815(Y)
Q5 : 2SA1015(Y)
D14~34,66,101 : 1S1555
D35 : XZ-051
SW UNIT (X41-1410-00)(C)
SW UNIT (X41-1410-00)(D)
D6~13,100 : 1S1555
SW UNIT (X41-1410-00)(A)
(X41-1410-00)(E)
SW UNIT(X41-1410-00)(F)
Q1,2 : 2N5885
D1 : S15VB10
RIT ENCODER UNIT (X54-1690-00)
MAIN ENCODER UNIT (X54-1680-00)
BATTERY
SW UNIT (X41-1410-00)(J)
SW UNIT (X41-1410-00)(K)
SW UNIT (X41-1410-00)(H)
D1 : 1S1555
D2 : GM-3A
D67 : ERZ003DK331
SIGNAL UNIT(X57-1000-11)
POWER SUPPLY UNIT(X43-1430-00)
Q1 : 2SA1321(O)
Q2~4 : 2SC1815(Y)
Q5 : 2SC1959(Y)
D1,2 : V03(C)
D3 : XZ-122
D4,6 : 1S1555
D5 : WZ-182
D7 : BZ-320
D8 : SV-03Y
SW UNIT(X41-1410-00)(M)
D38~49 : 1S1555
SW UNIT (X41-1410-00)(L)
D50~65 : 1S1555
SW UNIT (X41-1410-00)(N)
D36,37 : 1S1555
SW UNIT (X41-1410-00)(I)
PHONE
KEY
EXT SP
SP
REMOTE
LINE IN
AF OUT
LINE OUT
EXT RX ANT
X VTER
POWER
FAN
ANT

TS-930S SIGNAL UNIT (X57-1000-11)

From S/N208XXXX–309XXXX

Signal Line — Control Line — Common DC Line

The voltages measured when receiving 14.175MHz, SSB MODE, RF GAIN : MAX. ( ) : in TX.
C : CW MODE, 100W OUTPUT, F : FSK MODE, M : MONITOR ON, T : TUNE MODE, S, P : SSB MODE, PROCESSOR ON


SIGNAL UNIT (X57-1000-11)
IC1 SN74LS145N
IC2,9 TC4011BP
IC3 HA1368
IC4,7 MB3614
IC5 NJM2903D
IC6 TA7302P
BUZZER OSC
SIDE TONE MIX
DE TONE LEVEL
SWR METER
D102 : MV-13
D100,115,224 : WZ-071
D101 : ERZC07DK201
D47,122,197 : 1SV54GE
D140 : ND487R1-3R
D148 : WZ-061
D217,244 : FC65M
D252 : XZ-070
D71,125,10,25 : WZ-040
D72,183,210 : WZ-120
D77 : XZ-200
D80,81,88~90,93,96,97 : 1S1007
D83,167 : WZ-090
D36,37 : XZ-033
D39 : XZ-051
D44 : 1JZ61
D45,46 : 1SV54GC
D51,73,223,232,251 : WZ-150
D52~55, 238~241 : 1N60
D56,67,120,222,225,245 : LT8001P

Terminals		Colro	Destination
No.		Name	
1	1 AT1	YEL	SW (M)
	2 AT2	BLU	
2	1 MKR	GRY	PLL unit ⑥
	2 G		
3	1 PL5	GRN	PLL unit ②
	2 AT4	BLU	PLL unit ①
	3 ABO	–	–
4	1 RB3	YEL	Digital unit ⑪
	2 RB2	WHT/GRN	
	3 RB1	WHT/VIO	
	4 RB0	WHT/BLU	
5	1 VSR	ORG	LPF unit ⑤
	2 G		
	3 G		
	4 VSF	RED	
	5 TV	GRN	LPF unit ①
	6 BST	ORG	
	7 THP	YEL	
	8 18	RED	Final unit ①

Terminals No.		Name	Color	Destination
⑥	1	FCB	BRN	PLL unit ①
	2	VCH	RED	PLL unit ③
	3	VCM	ORG	
	4	VCL	YEL	
	5	FCV	RED	PLL unit ①
	6	FCG		
⑦	1	NA	GRY	Signal unit ㉗
	2	G		
	3	NBB		
	4	NG1	GRY	
⑧	1	G		
	2	ISW	BLU	AT unit ②
⑨	1	ICA	BRN	Power supply unit ⑥
	2	ICB	WHT	
⑩	1	NG2	YEL	Signal unit ㉕
	2	G		
⑪	1	FSK	WHT	SW (A) MODE SW S10-1
	2	PRM	BRN	SW (E) METER SW
	3	PRS	ORG	SW (C)
	4	PRL	YEL	SW (D) VR1-2

Terminals No.		Name	Color	Destination
⑫	1	MV2	BLU	SW (C) PRO SW S8
	2	G		
	3	CWN	RED	SW (C)
	4	AMN	ORG	
	5	AMW	YEL	
	6	VF2	GRN	SW (A)
⑬	1	G		PLL unit ⑤ 3
	2	AFS	RED	PLL unit ⑤ 4
⑭	1	DLY	GRY	SW (K)
	2	V12	VIO	
	3	ANV	BRN	
	4	VXC	WHT	
	5	VX2	RED	
	6	VX1	BLU	
	7	G		
⑮	1	MV1	RED	SW (D) VR1-1
	2	G		
	3	SSA	BRN	SW(A)
⑯	1	G		
	2	MCL	BLU	SW (J)

Termianls No.		Name	Color	Destination
⑰	1	G		
	2	MCH	–	–
⑱	1	LINE	BLU	LINE IN jack
	2	G		
⑲	1	AGO	VIO	SW (E)
	2	RFG	YEL	SW (F)
	3	NTH	ORG	SW (F)
	4	NAM	WHT	SW (E)
	5	AGS	GRY	SW (E)
⑳	1	G		
	2	IFO	GRY	IF OUT terminal
㉑	1	AM	VIO	SW (A)
	2	CW	GRY	SW (A)
	3	CWP	WHT	SW (A)
	4	AP5	BRN	SW (N)
	5	AP4	RED	SW (A)
	6	AP2	ORG	
	7	AP3	GRN	
	8	AP1	YEL	
	9	M	BLU	METER
	10	TM	WHT/BRN	SW (E)
	11	AP0	WHT/RED	SW (N)

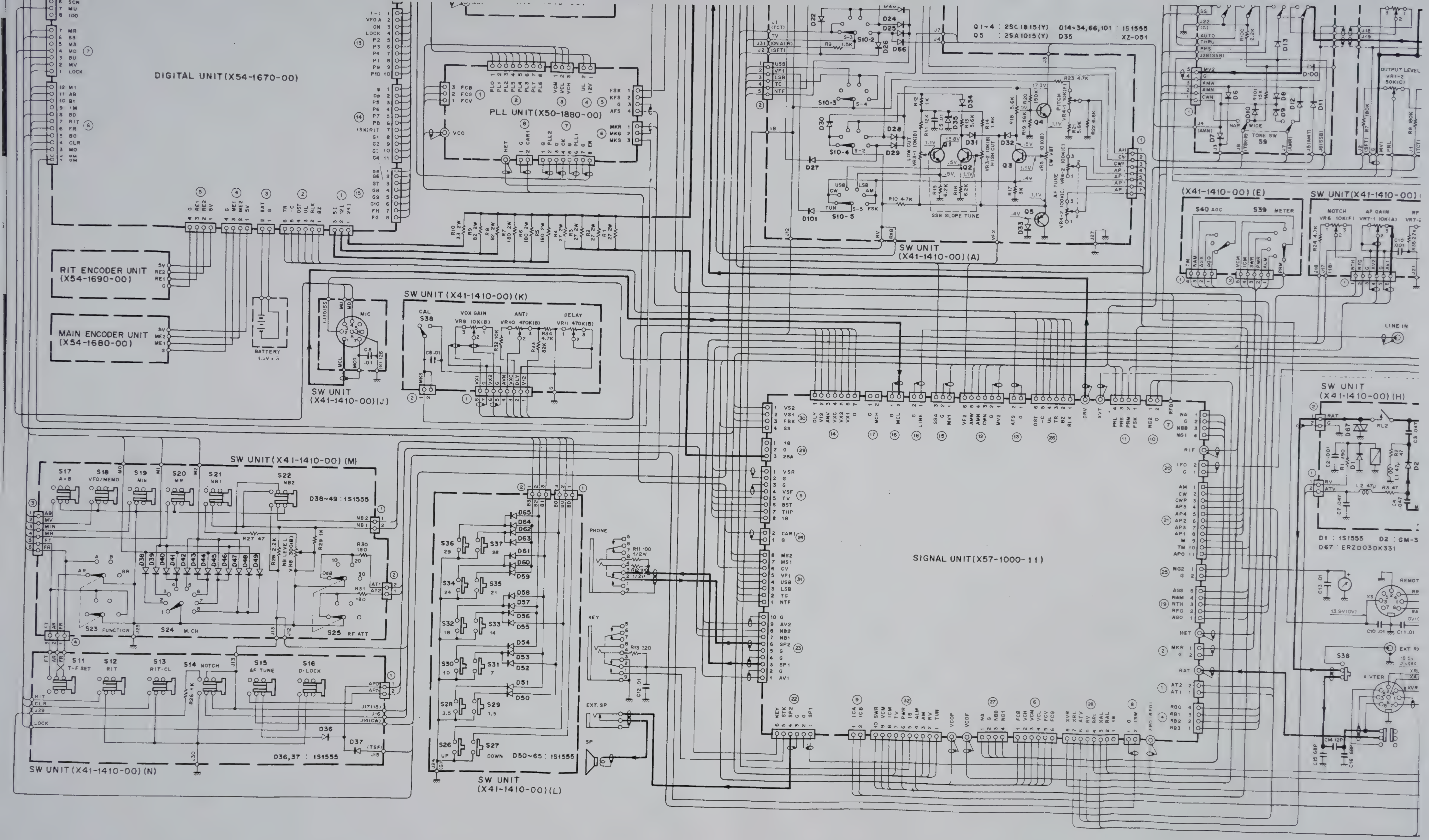
Terminals No.		Name	Color	Destination
㉒	1	SP1	RED	LINE OUT terminal
	2	G		
	3	G		
	4	SP2	ORG	EXT. SP jack
	5	STK	VIO	KEY jack
	6	KEY	GRY	KEY jack
㉓	1	AV1	RED	SW (F)
	2	G		
	3	SP1	ORG	PHONE jack
	4	G		
	5	G		
	6	SP2	YEL	PHONE jack
	7	NB1	GRN	SW (M) NB2 SW
	8	NB2	BLU	
	9	AV2	BLU	SW (F)
	10	G		
㉔	1	G		
	2	CAR1	GRY	PLL unit 8
㉕	1	NG2	YEL	Signal unit ⑩
	2	G		

Terminals No.		Name	Color	Destination
㉖	1	BLK	GRN	Digital unit ②
	2	BZ	BLU	
	3	TR	VIO	
	4	UL	GRY	
	5	–C	WHT	
	6	DST	BRN	
㉗	1	NA	GRY	Signal unit ⑦
	2	G		
	3	NBB		
	4	NG1	GRY	
㉘	1	18	–	
	2	RAL	WHT	REMOTE socket
	3	XAL	BRN	X VTER socket
	4	RRL	VIO	REMOTE socket
	5	RV	ORG	SW (H)
	6	ATV	YEL	SW (H)
	7	XGL	GRN	X. VTER socket
	8	XVR	BLU	X. VTER socket
㉙	1	18	–	–
	2	G		
	3	28A	YEL	R1 – R3 27Ω 2W

Terminals No.		Name	Color	Destination
㉚	1	VS2	YEL	SW (I) VOX/MAN SW S2
	2	VS1	GRN	SW (I) VOX/MAN SW S2
	3	FBK	BLU	SW (I) FULL/SEMI SW S3
	4	SS	VIO	SW (C) STBY SW S6
㉛	1	NTF	WHT	SW (A)
	2	TC	GRY	SW (A)
	3	LSB	VIO	SW (A)
	4	USB	BLU	SW (A)
	5	VF1	GRN	SW (A) MODE SW S10-5
	6	CV	YEL	SW (D) VR2-2
	7	MS1	ORG	SW (I) MONI SW S4
	8	MS2	BRN	SW (I) MONI SW S4
㉜	1	TUN	BRN	SW (A) MODE SW S10-1
	2	RV	GRN	SW (A) MODE SW S10-4
	3	AM	ORG	SW (A) MODE SW S10-1
	4	ALM	YEL	SW (E)
	5	18	RED	SW (A) MODE SW S10-3
	6	PWR	BLU	SW (E)
	7	TV	VIO	SW (A) MODE SW S10-2
	8	ICM	GRY	SW (E)
	9	VCM	WHT	
	10	SWR	BRN/WHT	

Terminal name	Color	Destination
VCOP	BLK	PLL unit "VCO"
VCOF	GRY	RF unit "VCOF"
RFO (FRO)	GRY	RF unit "RFO"
RAT	GRY	X. VTER jack SW
HET	BLK	PLL unit "HET"
RIF	GRY	RF unit "RIF"
XVT	GRY	X. VTER jack
DRV	GRY	Final unit "IN"

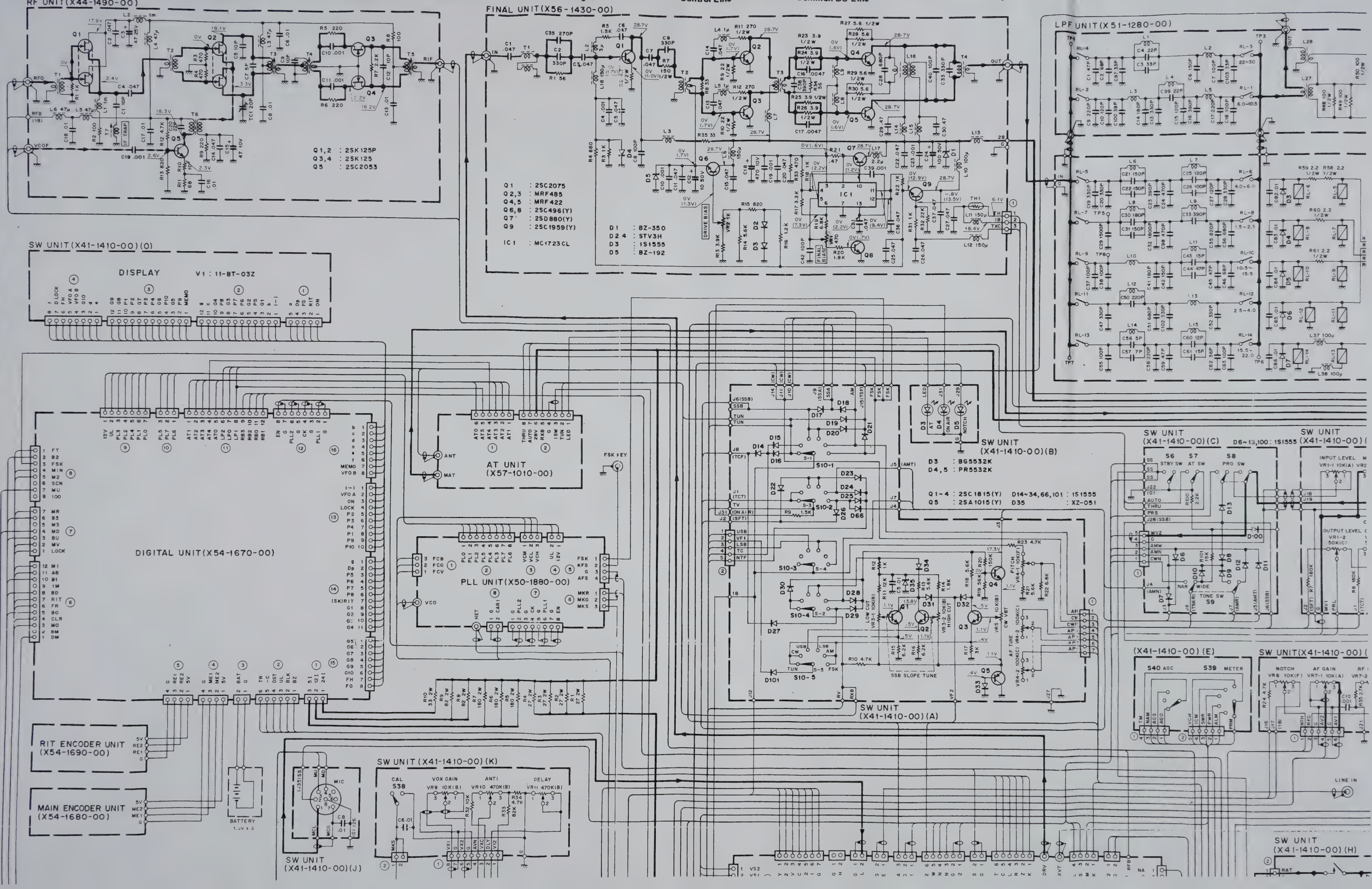
RED	RED
ORG	ORANGE
VIO	VIOLET
GRY	GRAY
WHT	WHITE
YEL	YELLOW
BLU	BLUE
BRN	BROWN
GRN	GREEN
BLK	BLACK


DIGITAL UNIT(X54-1670-00)
PLL UNIT(X50-1880-00)
RIT ENCODER UNIT (X54-1690-00)
MAIN ENCODER UNIT (X54-1680-00)
BATTERY 1.5V x 3
SW UNIT (X41-1410-00)(J)
SW UNIT (X41-1410-00)(K)
CAL S38
VOX GAIN VR9 10K(B)
ANTI VR10 470K(B)
DELAY VR11 470K(B)
MIC
SW UNIT (X41-1410-00)(A)
SSB SLOPE TUNE
Q1~4 : 2SC1815(Y) D14~34,66,101 : 1S1555
Q5 : 2SA1015(Y) D35 : XZ-051
(X41-1410-00)(E)
S40 AGC
S39 METER
SW UNIT(X41-1410-00)
NOTCH VR6 10K(F)
AF GAIN VR7-1 10K(A)
OUTPUT LEVEL VR1-2 50K(C)
TONE SW S9
LINE IN
SW UNIT(X41-1410-00)(M)
S17 A=B
S18 VFO/MEMO
S19 MIN
S20 MR
S21 NB1
S22 NB2
D38~49 : 1S1555
S23 FUNCTION
S24 M.CH
S25 RF ATT
NB LEVEL VR8 100K(B)
S11 T-F SET
S12 RIT
S13 RIT-CL
S14 NOTCH
S15 AF TUNE
S16 D-LOCK
D36,37 : 1S1555
SW UNIT(X41-1410-00)(N)
SW UNIT (X41-1410-00)(L)
D50~65 : 1S1555
S26 UP
S27 DOWN
PHONE
KEY
EXT.SP
SP
SIGNAL UNIT(X57-1000-11)
SW UNIT (X41-1410-00)(H)
D1 : 1S1555 D2 : GM-3
D67 : ERZD03DK331
REMOTE
EXT RX
X VTER
S38

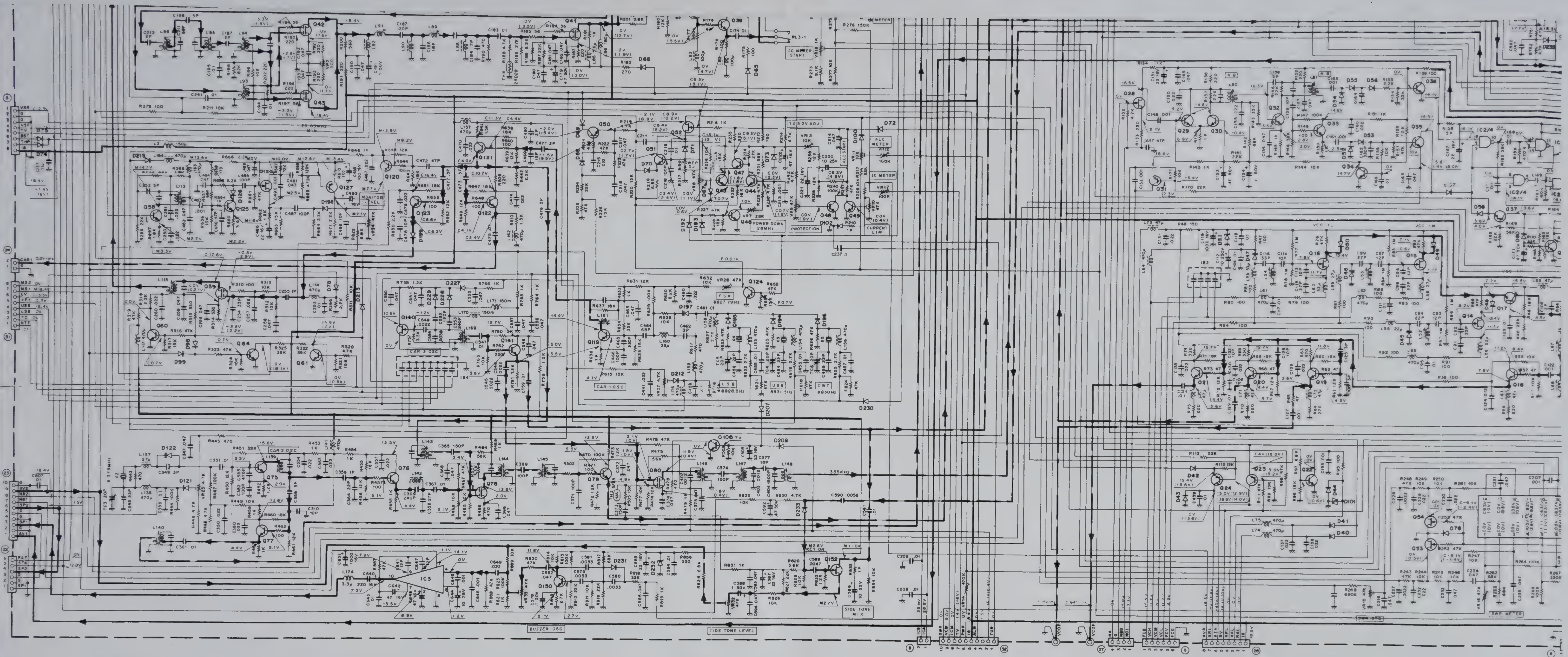
TS-930S SCHEMATIC DIAGRAM

From S/N208XXXX–309XXXX

Signal Line Control Line Common DC Line



A
B
C
D
E
F
G
H
I
J
RF UNIT(X44-1490-00)
Q1,2 : 2SK125P
Q3,4 : 2SK125
Q5 : 2SC2053
FINAL UNIT(X56-1430-00)
Q1 : 2SC2075
Q2,3 : MRF485
Q4,5 : MRF422
Q6,8 : 2SC496(Y)
Q7 : 2SD880(Y)
Q9 : 2SC1959(Y)
IC1 : MC1723CL
D1 : BZ-350
D2,4 : STV3H
D3 : 1S1555
D5 : BZ-192
DRIVE BIAS
FINAL BIAS
LPF UNIT(X51-1280-00)
SW UNIT(X41-1410-00)(0)
DISPLAY
V1 : 11-BT-03Z
DIGITAL UNIT(X54-1670-00)
AT UNIT (X57-1010-00)
ANT
MAT
FSK KEY
PLL UNIT(X50-1880-00)
VCO
SW UNIT (X41-1410-00)(B)
D3 : BG5532K
D4,5 : PR5532K
Q1~4 : 2SC1815(Y)
Q5 : 2SA1015(Y)
D14~34,66,101 : 1S1555
D35 : XZ-051
SSB SLOPE TUNE
SW UNIT (X41-1410-00)(A)
SW UNIT (X41-1410-00)(C)
D6~13,100 : 1S1555
S6 STBY SW
S7 AT SW
S8 PRO SW
TONE SW S9
(X41-1410-00) (E)
S40 AGC
S39 METER
SW UNIT(X41-1410-00)
NOTCH
AF GAIN
RIT ENCODER UNIT (X54-1690-00)
MAIN ENCODER UNIT (X54-1680-00)
BATTERY
SW UNIT (X41-1410-00)(J)
MIC
SW UNIT (X41-1410-00) (K)
CAL S38
VOX GAIN
ANTI
DELAY
LINE IN
SW UNIT (X41-1410-00) (H)


BUZZER OSC
SIDE TONE LEVEL
SIDE TONE MIX
CAR 1 OSC
CAR 2 OSC
CAR 3 OSC
MONITOR LVL
POWER DOWN 28MHz
PROTECTION
CURRENT LIM
TX 3.2V ADJ
ALC METER
IC METER
IC METER START
METER
LSB
USB
CWT
355KHz
SWR METER

Terminals No.		Name	Colro	Destination
1	1	AT1	YEL	SW (M)
	2	AT2	BLU	
2	1	MKR	GRY	PLL unit 6
	2	G		
3	1	PL5	GRN	PLL unit 2
	2	AT4	BLU	PLL unit 1
	3	ABO	–	–
4	1	RB3	YEL	Digital unit 11
	2	RB2	WHT/GRN	
	3	RB1	WHT/VIO	
	4	RB0	WHT/BLU	
5	1	VSR	ORG	LPF unit 5
	2	G		
	3	G		
	4	VSF	RED	
	5	TV	GRN	LPF unit 1
	6	BST	ORG	
	7	THP	YEL	
	8	18	RED	Final unit 1

Terminals No		Name	Color	Destination
6	1	FCB	BRN	PLL unit 1
	2	VCH	RED	PLL unit 3
	3	VCM	ORG	
	4	VCL	YEL	
	5	FCV	RED	PLL unit 1
	6	FCG		
7	1	NA	GRY	Signal unit 27
	2	G		
	3	NBB		
	4	NG1	GRY	
8	1	G		
	2	ISW	BLU	AT unit 2
9	1	ICA	BRN	Power supply unit 6
	2	ICB	WHT	
10	1	NG2	YEL	Signal unit ㉕
	2	G		
11	1	FSK	WHT	SW (A) MODE SW S10-1
	2	PRM	BRN	SW (E) METER SW
	3	PRS	ORG	SW (C)
	4	PRL	YEL	SW (D) VR1-2

Terminals No		Name	Color	Destination
12	1	MV2	BLU	SW (C) PRO SW S8
	2	G		
	3	CWN	RED	SW (C)
	4	AMN	ORG	
	5	AMW	YEL	
	6	VF2	GRN	SW (A)
13	1	G		PLL unit 5 3
	2	AFS	RED	PLL unit 5 4
14	1	DLY	GRY	SW (K)
	2	V12	VIO	
	3	ANV	BRN	
	4	VXC	WHT	
	5	VX2	RED	
	6	VX1	BLU	
	7	G		
15	1	MV1	RED	SW (D) VR1-1
	2	G		
	3	SSA	BRN	SW(A)
16	1	G		
	2	MCL	BLU	SW (J)

Termiants No		Name	Color	Destination
17	1	G		
	2	MCH	–	–
18	1	LINE	BLU	LINE IN jack
	2	G		
19	1	AGO	VIO	SW (E)
	2	RFG	YEL	SW (F)
	3	NTH	ORG	SW (F)
	4	NAM	WHT	SW (E)
	5	AGS	GRY	SW (E)
20	1	G		
	2	IFO	GRY	IF OUT terminal
21	1	AM	VIO	SW (A)
	2	CW	GRY	SW (A)
	3	CWP	WHT	SW (A)
	4	AP5	BRN	SW (N)
	5	AP4	RED	SW (A)
	6	AP2	ORG	
	7	AP3	GRN	
	8	AP1	YEL	
	9	M	BLU	METER
	10	TM	WHT/BRN	SW (E)
	11	AP0	WHT/RED	SW (N)

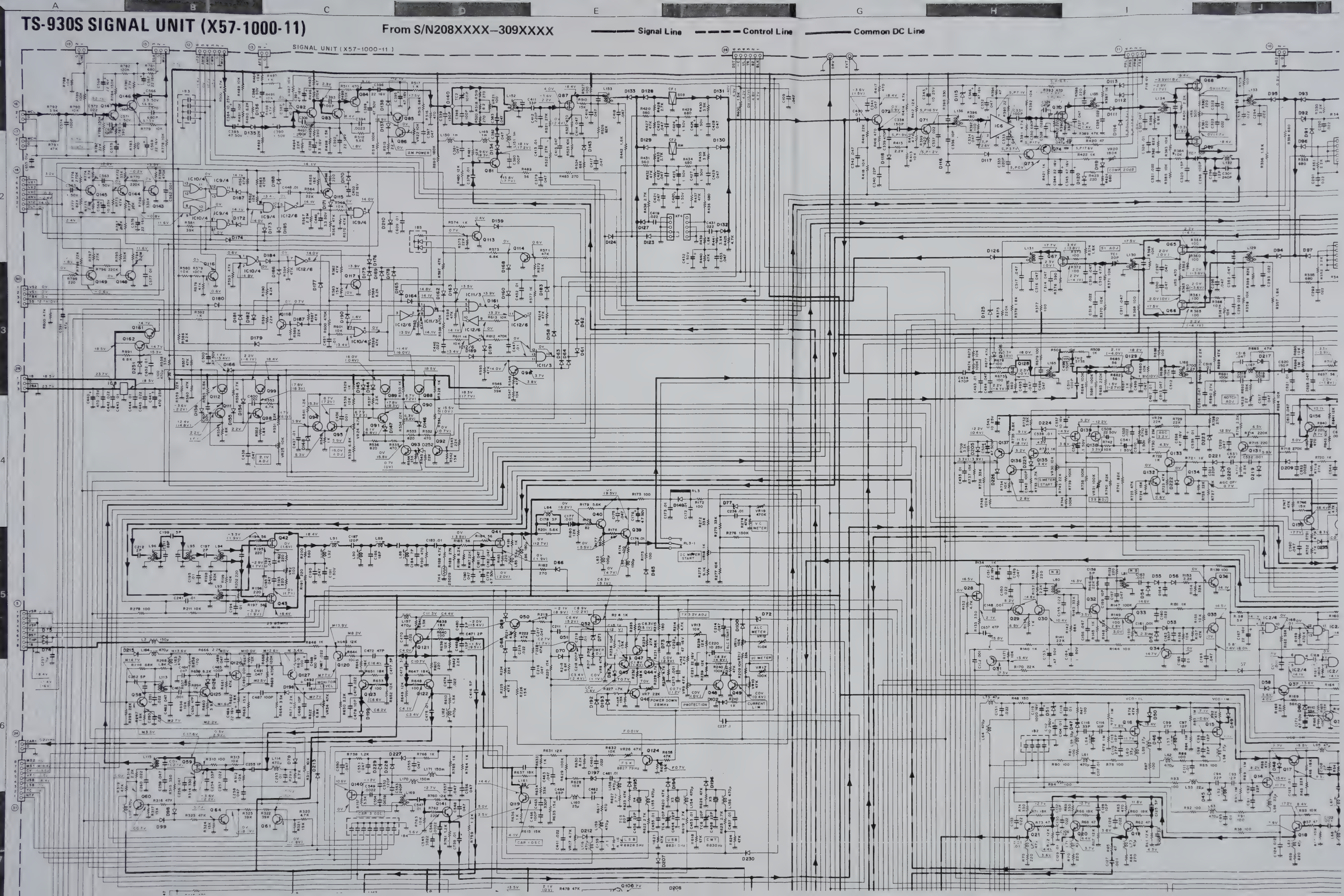
Terminals No.		Name	Color	Destination
22	1	SP1	RED	LINE OUT terminal
	2	G		
	3	G		
	4	SP2	ORG	EXT. SP jack
	5	STK	VIO	KEY jack
	6	KEY	GRY	KEY jack
23	1	AV1	RED	SW (F)
	2	G		
	3	SP1	ORG	PHONE jack
	4	G		
	5	G		
	6	SP2	YEL	PHONE jack
	7	NB1	GRN	SW (M) NB2 SW
	8	NB2	BLU	
	9	AV2	BLU	SW (F)
	10	G		
24	1	G		
	2	CAR1	GRY	PLL unit 8
25	1	NG2	YEL	Signal unit 10
	2	G		

Terminals No		Name	Color	Destination
26	1	BLK	GRN	Digital unit 2
	2	BZ	BLU	
	3	TR	VIO	
	4	UL	GRY	
	5	–C	WHT	
	6	DST	BRN	
27	1	NA	GRY	Signal unit 7
	2	G		
	3	NBB		
	4	NG1	GRY	
28	1	18	–	
	2	RAL	WHT	REMOTE socket
	3	XAL	BRN	X VTER socket
	4	RRL	VIO	REMOTE socket
	5	[illegible]V	ORG	SW (H)
	6	ATV	YEL	SW (H)
	7	XGL	GRN	X. VTER socket
	8	XVR	BLU	X. VTER socket
29	1	18	–	–
	2	G		
	3	28A	YEL	R1 – R3 27Ω 2W

TS-930S SIGNAL UNIT (X57-1000-11)

From S/N208XXXX–309XXXX

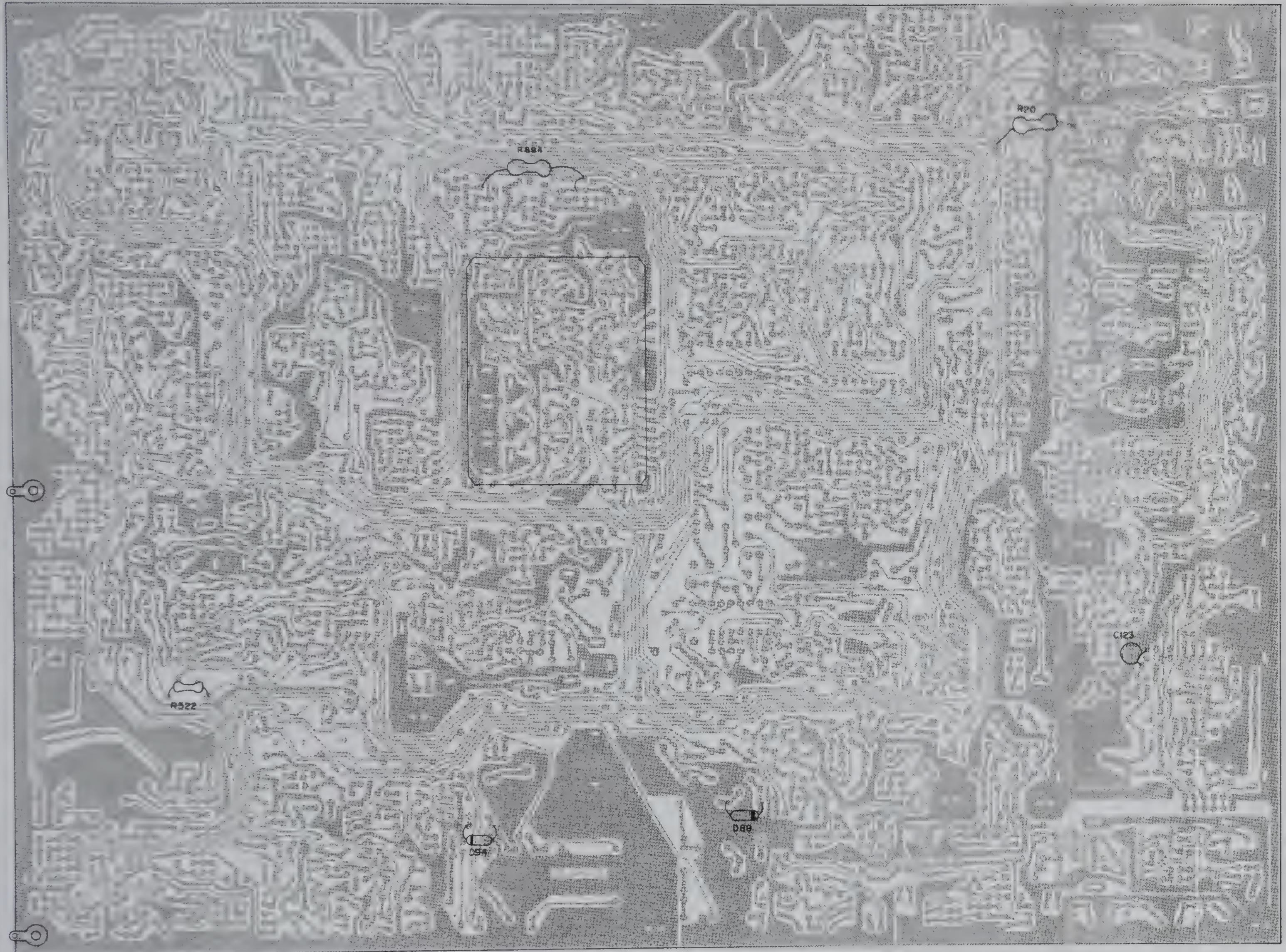
Signal Line
Control Line
Common DC Line



A
B
C
D
E
F
G
H
I
J
1
2
3
4
5
6
7
SIGNAL UNIT (X57-1000-11)
FM POWER
COMP 20dB
NOTCH ADJ
S METER START
SS ADJ
AGC OFF
NB
TX 3.2V ADJ
ALC METER
ALC START
IC METER
VC METER
IC METER START
POWER DOWN 28MHz
PROTECTION
CURRENT LIM
MONITOR LEVEL
FSK
USB
LSB
CWT
CAR 1 OSC
CAR 3 OSC
VCO-1L
VCO-1M

TS-930S PC BOARD VIEWS

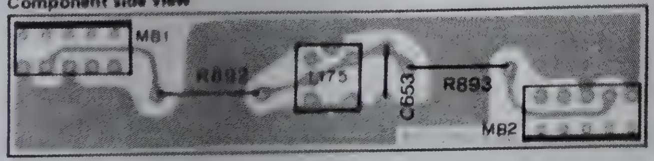
SIGNAL UNIT (X57-1000-11) A/2 From S/N310XXXX– Foil side view

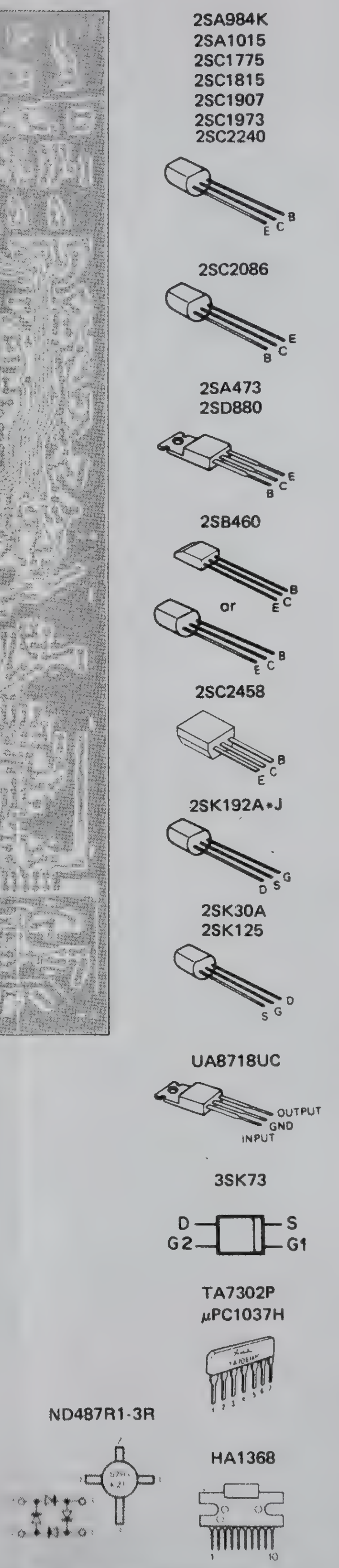


Q11,12,24,31,74,84,85,99,112,115,127,137,153,160 : 2SA1015(Y)
Q13,34–38,44–47,50,51,60,61,64,73,83,86,90–98,100,111,113,114,116–118,124,132–134,136,141–145,148–151,156,157,162 : 2SC1815(Y)
Q14–16,28,140,152,158 : 2SK192A•J(GR) Q17–21,25,26,40 : 2SC1907 Q22 : 2SD799 Q23 : 2SA984K(E)
Q27,29,30,32,33,58,71,72,75–77,79,119–123,125,131 : 2SC460(B) Q39 : 2SC1973(T) Q41–43,55–57,59,65–70,78,80,87,128–130 : 3SK73(GR)
Q48,49 : 2SC2458(Y) Q52 : 2SK30A(O) Q53,54,138,139,154,155 : 2SK30A(GR) Q62,63 : 2SK125 Q81 : 2SC2086
Q82 : 2SC2240(GR) Q88,89 : 2SA473(Y) Q135 : 2SK30A(Y) Q146,147,159 : 2SC1775(E) Q161 : 2SD880(Y)
IC1 : SN74LS145N IC2,9 : TC4011BP IC3 : HA1368 IC4,7 : MB3614 IC5 : NJM2903D IC6 : TA7302P
IC8 : UA7818UC IC10 : TC4001BP IC11 : TC4073BP IC12 : TC4049BP IC13 : µPC1037H
D1,2,15–33 : 1S2588 D10,71,125,206 : WZ-040 D11,12,38,40–43,57–66,68–70,74–76,78,91,92,98,99,106,108–110,112,113,116,117,119,
121,123,124,135–138,143–147,149–166,168–182,184–192,205,207–209,212,213,219,226–231,234–237,242,243,246–250 : 1S1555 or 1N4448
D13,48–50,79,82,84–87,89,94–96,111,114,118,126–134,194–196,198–200,216,221,233 : 1S1587 D34,35 : BA379 D36,37 : XZ-033
D39 : XZ-051 D44 : 1JZ61(W) D45,46 : 1SV54GC D47,122,197 : 1SV54GE D51,73,223,232,251 : WZ-150 D52–55,238–241 : 1N60
D56,67,120,222,225,245 : LT8001P D72,183,210 : WZ-120 D77 : XZ-200 D80,81,88,90,93,97 : 1S1007 D83,167 : WZ-090 D100,115,224 : WZ-071
D101 : ERZC07DK201 D102,148 : WZ-061 D107 : MV-203 D140 : ND487R1-3R D142,252 : WZ-070 D211 : MV-12 D217,244 : FC65M

SIGNAL UNIT (X57-1000-11) B/2

Component side view





TR, FET, IC and Terminals address from S/N 310XXXX–

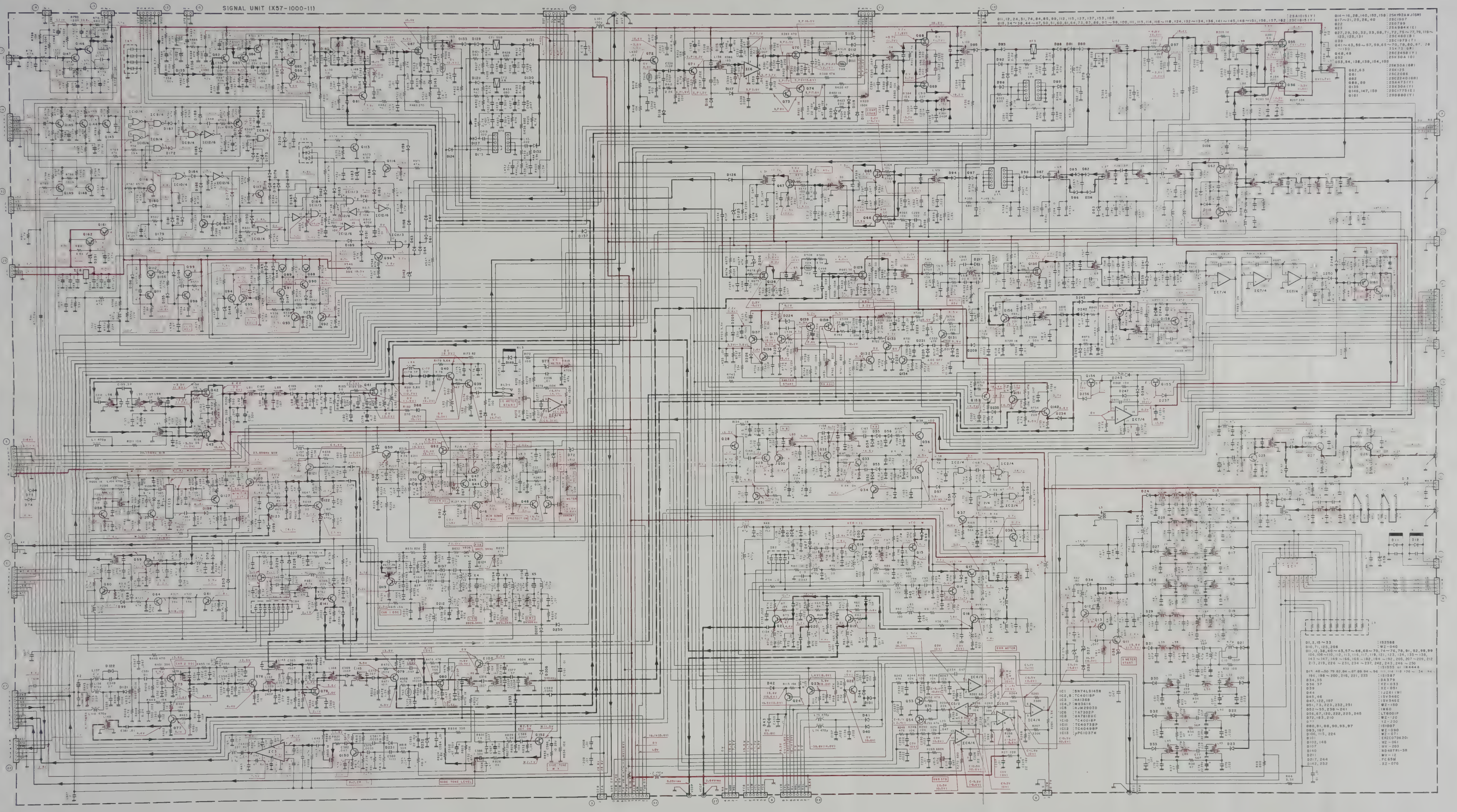
TR,FET	Address	TR,FET	Address	TR,FET	Address	Terminal	Address
Q1	Not used	Q71	G–6	Q141	F–3	①	A,B–1
Q2	Not used	Q72	G–6	Q142	F–3	②	B–1
Q3	Not used	Q73	G–6	Q143	E–4	③	B–2
Q4	Not used	Q74	G–6	Q144	E–3	④	B–3,4
Q5	Not used	Q75	E–5	Q145	E–3	⑤	B–4,5
Q6	Not used	Q76	E–4	Q146	E–3	⑥	A–6
Q7	Not used	Q77	E–4	Q147	F–3	⑦	C–6
Q8	Not used	Q78	E–4	Q148	E–2	⑧	C,D–5
Q9	Not used	Q79	E–4	Q149	E–2	⑨	D–5
Q10	Not used	Q80	F–4	Q150	F–2	⑩	E–6
Q11	A–3,4	Q81	F–4	Q151	F–2,3	⑪	F–6
Q12	A–4	Q82	F–5	Q152	F–2	⑫	F–4,5
Q13	A–4	Q83	F,G–5	Q153	F–2	⑬	E,F–4
Q14	A–4	Q84	G–5	Q154	F,G–2	⑭	E–3,4
Q15	A–5	Q85	G–4	Q155	F,G–2	⑮	E–3
Q16	A–5	Q86	F–4	Q156	G–2	⑯	F–2,3
Q17	A–5	Q87	G–4	Q157	G–1	⑰	F–2,3
Q18	A–5	Q88	B–1	Q158	G–1	⑱	F–3
Q19	B–4,5	Q89	C–1	Q159	G–1	⑲	G–3
Q20	A–4	Q90	B–1	Q160	G–1	⑳	G–2
Q21	A–4	Q91	C–1	Q161	F–1	㉑	G–2
Q22	C–1	Q92	B–1	Q162	E–1	㉒	F–1
Q23	C–1	Q93	C–1			㉓	F–1
Q24	C–1	Q94	B–1			㉔	D–2
Q25	A–6	Q95	B,C–1			㉕	D–1
Q26	A–6	Q96	B–1,2			㉖	D–1
Q27	B–6	Q97	Not used			㉗	D–1
Q28	D–1	Q98	B–3			㉘	C–1
Q29	D–1	Q99	B–3			㉙	C–1
Q30	D–1	Q100	F–4			㉚	D–2
Q31	D–1	Q101	Not used			㉛	D–3
Q32	D–1	Q102	Not used			㉜	D–3,4
Q33	D,E–1	Q103	Not used				
Q34	E–1	Q104	Not used				
Q35	E–1	Q105	Not used				
Q36	E–1	Q106	Not used				
Q37	E–1	Q107	Not used				
Q38	D,E–1	Q108	Not used				
Q39	B–1	Q109	Not used				
Q40	B–2	Q110	Not used				
Q41	B–2	Q111	B–3	IC1	A–4		
Q42	B–4	Q112	B–3	IC2	E–1		
Q43	B–4	Q113	C–2	IC3	F–1		
Q44	B–4	Q114	C–2	IC4	C–4		
Q45	B–4	Q115	C–2	IC5	C–5		
Q46	C–3	Q116	D–2	IC6	G–6		
Q47	C–4	Q117	D–2	IC7	G–1,2		
Q48	C–4	Q118	D–2	IC8	C–1		
Q49	C–4	Q119	E–2	IC9	C–2		
Q50	C–4	Q120	E–2	IC10	C,D–3		
Q51	C–3	Q121	D–3	IC11	C–2		
Q52	C–3	Q122	D–2	IC12	C–3		
Q53	C–5	Q123	D–3	IC13	E-2		
Q54	C–4,5	Q124	D–3				
Q55	B–5	Q125	E–2				
Q56	B–6	Q126	Not used				
Q57	C–6	Q127	E–2				
Q58	C–5,6	Q128	G–4				
Q59	C–5	Q129	G–4				
Q60	C–5	Q130	G–3				
Q61	C–5	Q131	G–2				
Q62	B–6	Q132	G–2				
Q63	B–6	Q133	G–2				
Q64	E–5	Q134	G–2,3				
Q65	E–6	Q135	G–3				
Q66	E–6	Q136	F–3				
Q67	F–6	Q137	F,G–3				
Q68	F–6	Q138	G–3				
Q69	F–6	Q139	G–4				
Q70	F–6	Q140	F–3				

TS-930S SIGNAL UNIT (X57-1000-11)

From S/N310XXXX–

Signal Line — Control Line — Common DC Line

The voltages measured when receiving 14.175MHz, SSB MODE, RF GAIN : MAX. ( ) : in TX.
C : CW MODE, 100W OUTPUT, F : FSK MODE, M : MONITOR ON, T : TUNE MODE, S, P : SSB MODE, PROCESSOR ON


SIGNAL UNIT (X57-1000-11)
Q11,12,24,31,74,84,85,99,112,115,127,137,153,160 :2SA1015(Y)
Q18,34~38,44~47,50,51,60,61,64,73,83,86,90~98,100,111,113,114,116~118,124,132~134,136,141~145,148~151,156,157,162 :2SC1815(Y)
Q14~16,28,140,152,158 :2SK192AKJ(GR)
Q17~21,25,26,40 :2SC1907
Q22 :2SD799
Q23 :2SA984K(E)
Q27,29,30,32,33,58,71,72,75~77,79,119~123,125,131 :2SC460(B)
Q39 :2SC1973(T)
Q41~43,56~57,59,65~70,78,80,87,28~130 3SK73(GR)
Q48,49 :2SC2458(Y)
Q52 :2SK30A(O)
Q53,54,138,139,154,155 :2SK30A(GR)
Q62,63 :2SK125
Q81 :2SC2086
Q82 :2SC2240(GR)
Q88,89 :2SA473(Y)
Q135 :2SK30A(Y)
Q146,147,159 :2SC1775(E)
Q161 :2SD880(Y)
IC1 :SN74LS145N
IC2,9 :TC4011BP
IC3 :HA1368
IC4,7 :MB3614
IC5 :NJM2903D
IC6 :TA7302P
IC8 :UA7818UC
IC10 TC40018P
IC11 :TC4073BP
IC12 :TC4049BP
IC13 :μPC1037H
D1,2,15~33 :1S2588
D10,71,125,206 :WZ-040
D11,12,38,40~43,57~66,68~70,74~76,78,91,92,98,99,106,108~110,112,113,116,117,119,121,123,124,135~138,143~147,149~166,168~182,184~192,205,207~209,212,213,219,226~231,234~237,242,243,246~250 :1S1555 or 1N4448
D13,48~50,79,82,84~87,89,94~96,111,114,118,126~134,194,196,198~200,216,221,233 :1S1587
D34,35 :BA379
D36,37 :XZ-033
D39 :XZ-051
D44 :1JZ61(W)
D45,46 :1SV54GC
D47,122,197 :1SV54GE
D51,73,223,232,251 :WZ-150
D52~55,238~241 :1N60
D56,67,120,222,225,245 :LT8001P
D72,183,210 :WZ-120
D77 XZ-200
D80,81,88,90,93,97 :1S1007
D83,167 :WZ-090
D100,115,224 :WZ-071
D101 :ERZC07DK201
D102,148 :WZ-061
D107 :MV-203
D140 :ND487R1-3R
D211 :MV-12
D217,244 :FC65M
D142,252 :XZ-070
SIDE TONE LEVEL
BUZZER
S METER START
SWR STD
0.25Vrms
0.64Vrms

Terminals			Colro	Destination
No		Name		
1	1	AT1	YEL	SW (M)
	2	AT2	BLU	
2	1	MKR	GRY	PLL unit ⑥
	2	G		
3	1	PL5	GRN	PLL unit ②
	2	AT4	BLU	PLL unit ①
	3	ABO	–	–
4	1	RB3	YEL	Digital unit ⑪
	2	RB2	WHT/GRN	
	3	RB1	WHT/VIO	
	4	RB0	WHT/BLU	
5	1	VSR	ORG	LPF unit ⑤
	2	G		
	3	G		
	4	VSF	RED	LPF unit ①
	5	TV	GRN	
	6	BST	ORG	
	7	THP	YEL	
	8	18	RED	Final unit ①

Terminals			Color	Destination
No		Name		
⑥	1	FCB	BRN	PLL unit ①
	2	VCH	RED	PLL unit ③
	3	VCM	ORG	
	4	VCL	YEL	
	5	FCV	RED	PLL unit ①
	6	FCG		
⑦	1	NA	GRY	Signal unit ㉗
	2	G		
	3	NBB		
	4	NG1	GRY	
⑧	1	G		
	2	ISW	BLU	AT unit ②
⑨	1	ICA	BRN	Power supply unit ⑥
	2	ICB	WHT	
10	1	NG2	YEL	Signal unit ㉕
	2	G		
⑪	1	FSK	WHT	SW (A) MODE SW S10-1
	2	PRM	BRN	SW (E) METER SW
	3	PRS	ORG	SW (C)
	4	PRL	YEL	SW (D) VR1-2

Terminals			Color	Destination
No.		Name		
⑫	1	MV2	BLU	SW (C) PRO SW S8
	2	G		
	3	CWN	RED	SW (C)
	4	AMN	ORG	
	5	AMW	YEL	
	6	VF2	GRN	SW (A)
⑬	1	G		PLL unit ⑤ 3
	2	AFS	RED	PLL unit ⑤ 4
⑭	1	DLY	GRY	SW (K)
	2	V12	VIO	
	3	ANV	BRN	
	4	VXC	WHT	
	5	VX2	RED	
	6	VX1	BLU	
	7	G		
⑮	1	MV1	RED	SW (D) VR1-1
	2	G		
	3	SSA	BRN	SW(A)
⑯	1	G		
	2	MCL	BLU	SW (J)

Termianls			Color	Destination
No.		Name		
⑰	1	G		
	2	MCH	–	–
⑱	1	LINE	BLU	LINE IN jack
	2	G		
⑲	1	AGO	VIO	SW (E)
	2	RFG	YEL	SW (F)
	3	NTH	ORG	SW (F)
	4	NAM	WHT	SW (E)
	5	AGS	GRY	SW (E)
⑳	1	G		
	2	IFO	GRY	IF OUT terminal
㉑	1	AM	VIO	SW (A)
	2	CW	GRY	SW (A)
	3	CWP	WHT	SW (A)
	4	AP5	BRN	SW (N)
	5	AP4	RED	SW (A)
	6	AP2	ORG	
	7	AP3	GRN	
	8	AP1	YEL	
	9	M	BLU	METER
	10	TM	WHT/BRN	SW (E)
	11	AP0	WHT/RED	SW (N)

Terminals			Color	Destination
No.		Name		
㉒	1	SP1	RED	LINE OUT terminal
	2	G		
	3	G		
	4	SP2	ORG	EXT. SP jack
	5	STK	VIO	KEY jack
	6	KEY	GRY	KEY jack
㉓	1	AV1	RED	SW (F)
	2	G		
	3	SP1	ORG	PHONE jack
	4	G		
	5	G		
	6	SP2	YEL	PHONE jack
	7	NB1	GRN	SW (M) NB2 SW
	8	NB2	BLU	
	9	AV2	BLU	SW (F)
	10	G		
㉔	1	G		
	2	CAR1	GRY	PLL unit ⑧
㉕	1	NG2	YEL	Signal unit ⑩
	2	G		

Terminals			Color	Destination
No		Name		
㉖	1	BLK	GRN	Digital unit ⑦
	2	BZ	BLU	
	3	TR	VIO	
	4	UL	GRY	
	5	–C	WHT	
	6	DST	BRN	
㉗	1	NA	GRY	Signal unit ⑦
	2	G		
	3	NBB		
	4	NG1	GRY	
㉘	1	18	–	
	2	RAL	WHT	REMOTE socket
	3	XAL	BRN	X VTER socket
	4	RRL	VIO	REMOTE socket
	5	RV	ORG	SW (H)
	6	ATV	YEL	SW (H)
	7	XGL	GRN	X. VTER socket
	8	XVR	BLU	X. VTER socket
㉙	1	18	–	–
	2	G		
	3	28A	YEL	R1 – R3 27Ω 2W

Terminals			Color	Destination
No.		Name		
㉚	1	VS2	YEL	SW (I) VOX/MAN SW S2
	2	VS1	GRN	SW (I) VOX/MAN SW S2
	3	FBK	BLU	SW (I) FULL/SEMI SW S3
	4	SS	VIO	SW (C) STBY SW S6
㉛	1	NTF	WHT	SW (A)
	2	TC	GRY	SW (A)
	3	LSB	VIO	SW (A)
	4	USB	BLU	SW (A)
	5	VF1	GRN	SW (A) MODE SW S10-5
	6	CV	YEL	SW (D) VR2-2
	7	MS1	ORG	SW (I) MONI SW S4
	8	MS2	BRN	SW (I) MONI SW S4
㉜	1	TUN	BRN	SW (A) MODE SW S10-1
	2	RV	GRN	SW (A) MODE SW S10-4
	3	AM	ORG	SW (A) MODE SW S10-1
	4	ALM	YEL	SW (E)
	5	18	RED	SW (A) MODE SW S10-3
	6	PWR	BLU	SW (E)
	7	TV	VIO	SW (A) MODE SW S10-2
	8	ICM	GRY	SW (E)
	9	VCM	WHT	
	10	SWR	BRN/WHT	

Terminal name	Color	Destination
VCOP	BLK	PLL unit "VCO"
VCOF	GRY	RF unit "VCOF
RFO (FRO)	GRY	RF unit "RFO"
RAT	GRY	X VTER jack SW
HET	BLK	PLL unit "HET"
RIF	GRY	RF unit "RIF"
XVT	GRY	X VTER jack
DRV	GRY	Final unit "IN

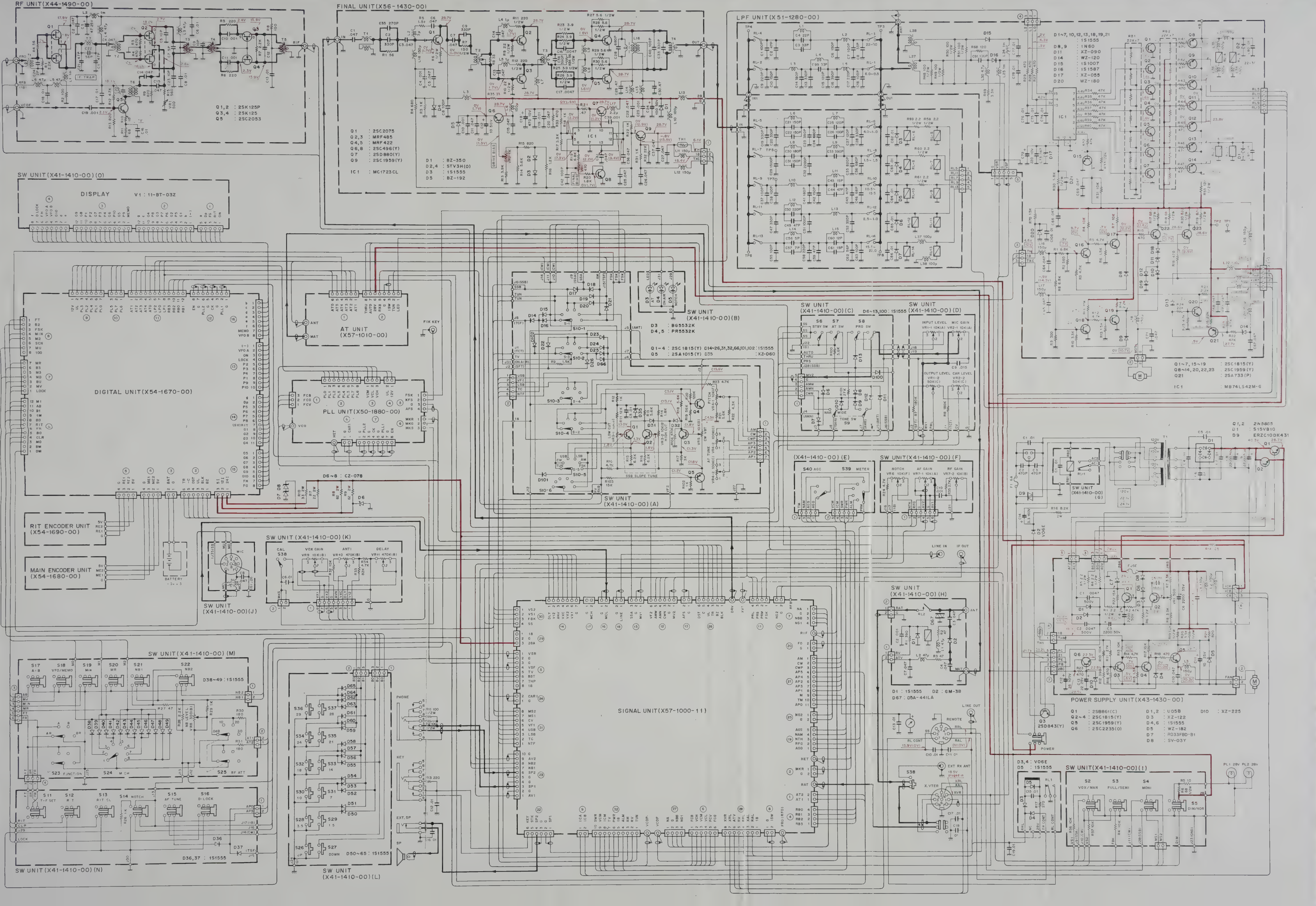
RED	RED
ORG	ORANGE
VIO	VIOLET
GRY	GRAY
WHT	WHITE
YEL	YELLOW
BLU	BLUE
BRN	BROWN
GRN	GREEN
BLK	BLACK

TS-930S SCHEMATIC DIAGRAM

From S/N310XXXX–

Signal Line — Control Line — Common DC Line

The voltages measured when receiving 14.175MHz, USB MODE. (   ) : in TX, ▭: Thermal protection ON.

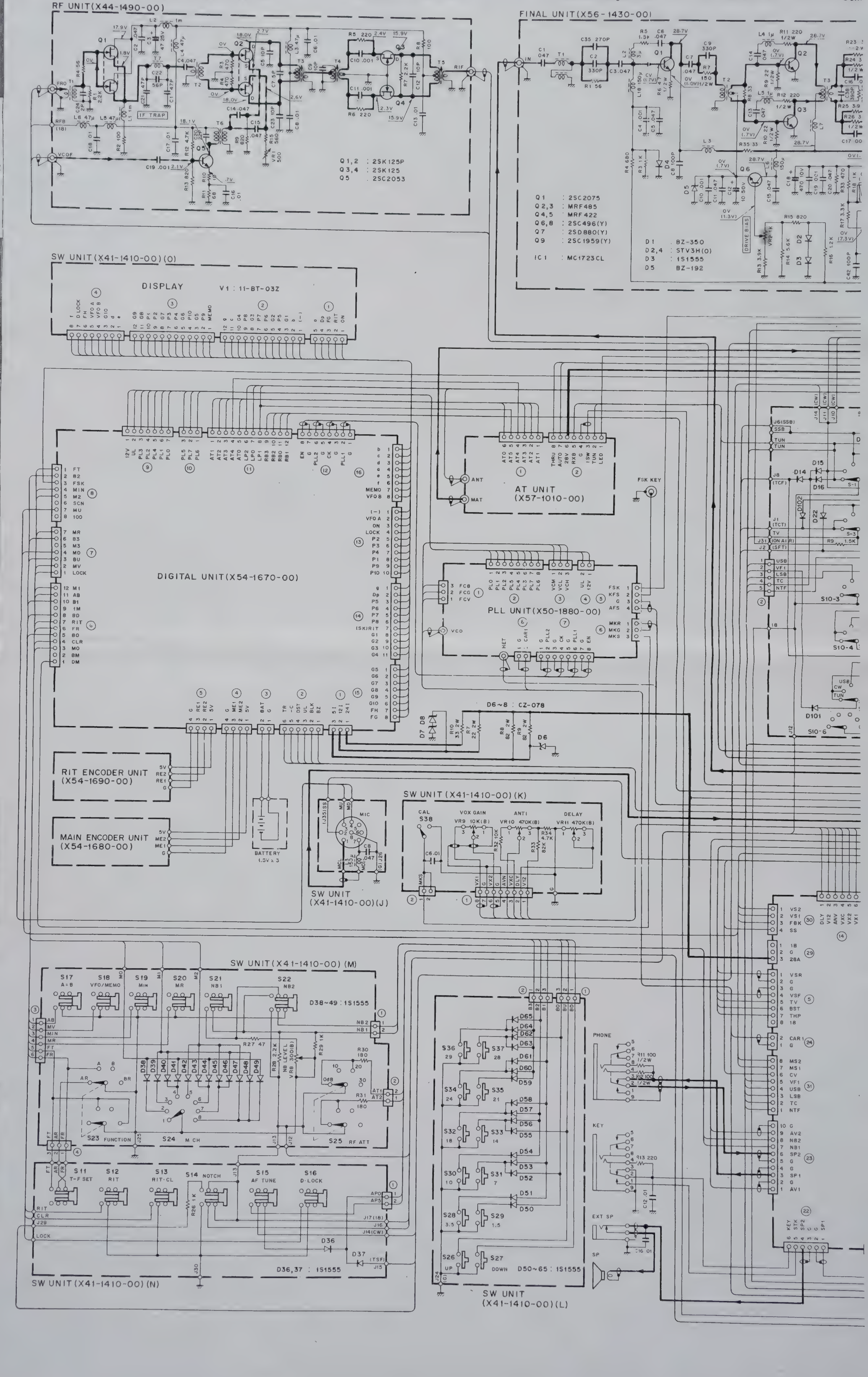


RF UNIT(X44-1490-00)
FINAL UNIT(X56-1430-00)
LPF UNIT(X51-1280-00)
SW UNIT(X41-1410-00)(O)
DISPLAY
DIGITAL UNIT(X54-1670-00)
AT UNIT (X57-1010-00)
PLL UNIT(X50-1880-00)
SW UNIT (X41-1410-00)(B)
SW UNIT (X41-1410-00)(A)
SW UNIT (X41-1410-00)(C)
SW UNIT (X41-1410-00)(D)
(X41-1410-00)(E)
SW UNIT(X41-1410-00)(F)
RIT ENCODER UNIT (X54-1690-00)
MAIN ENCODER UNIT (X54-1680-00)
SW UNIT (X41-1410-00)(J)
SW UNIT (X41-1410-00)(K)
SW UNIT (X41-1410-00)(M)
SW UNIT (X41-1410-00)(N)
SW UNIT (X41-1410-00)(L)
SIGNAL UNIT(X57-1000-11)
SW UNIT (X41-1410-00)(H)
SW UNIT (X41-1410-00)(G)
POWER SUPPLY UNIT(X43-1430-00)
SW UNIT(X41-1410-00)(I)

TS-930S SCHEMATIC DIAGRAM

From S/N310XXXX-

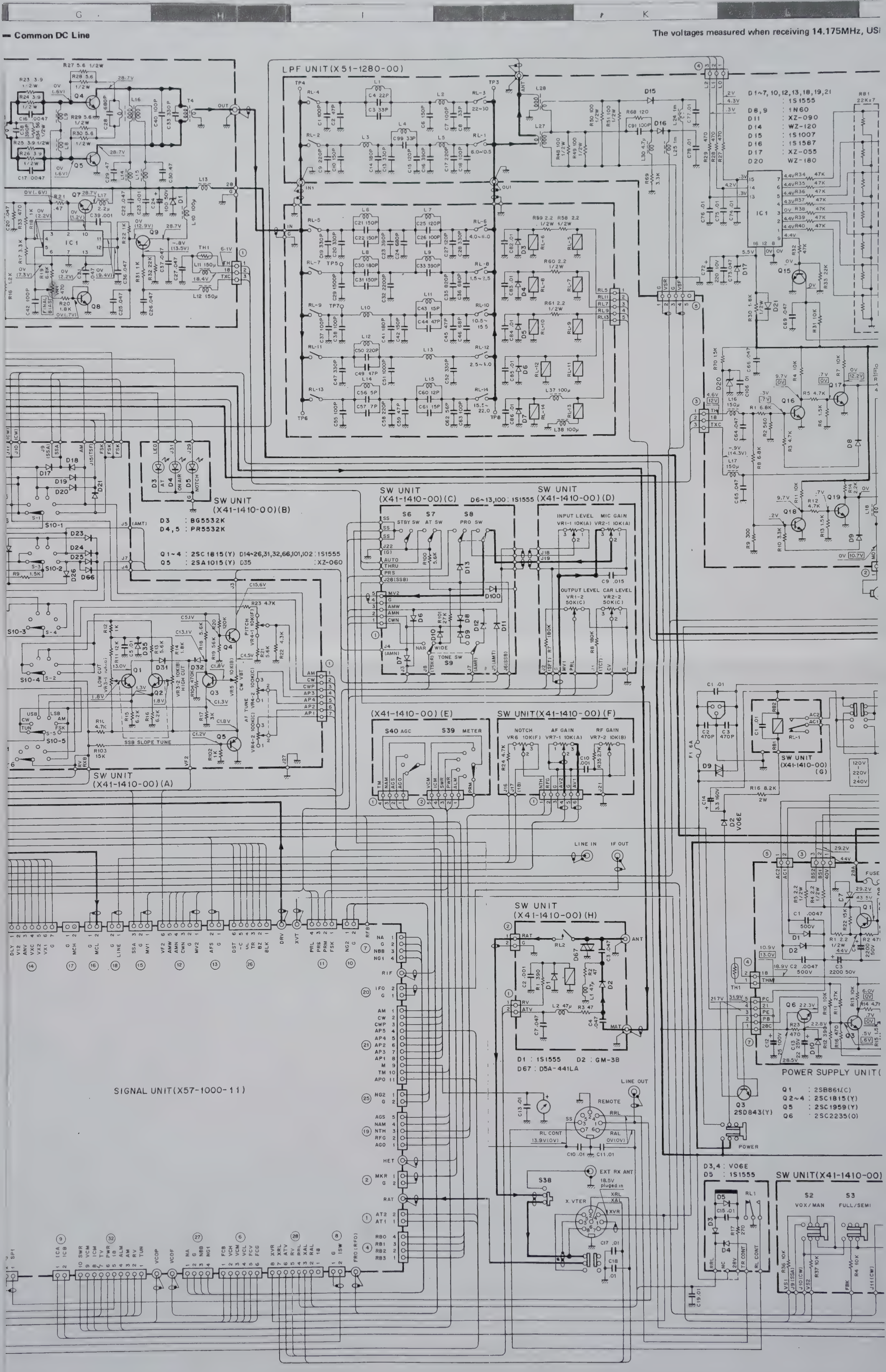
Signal Line
Control Line



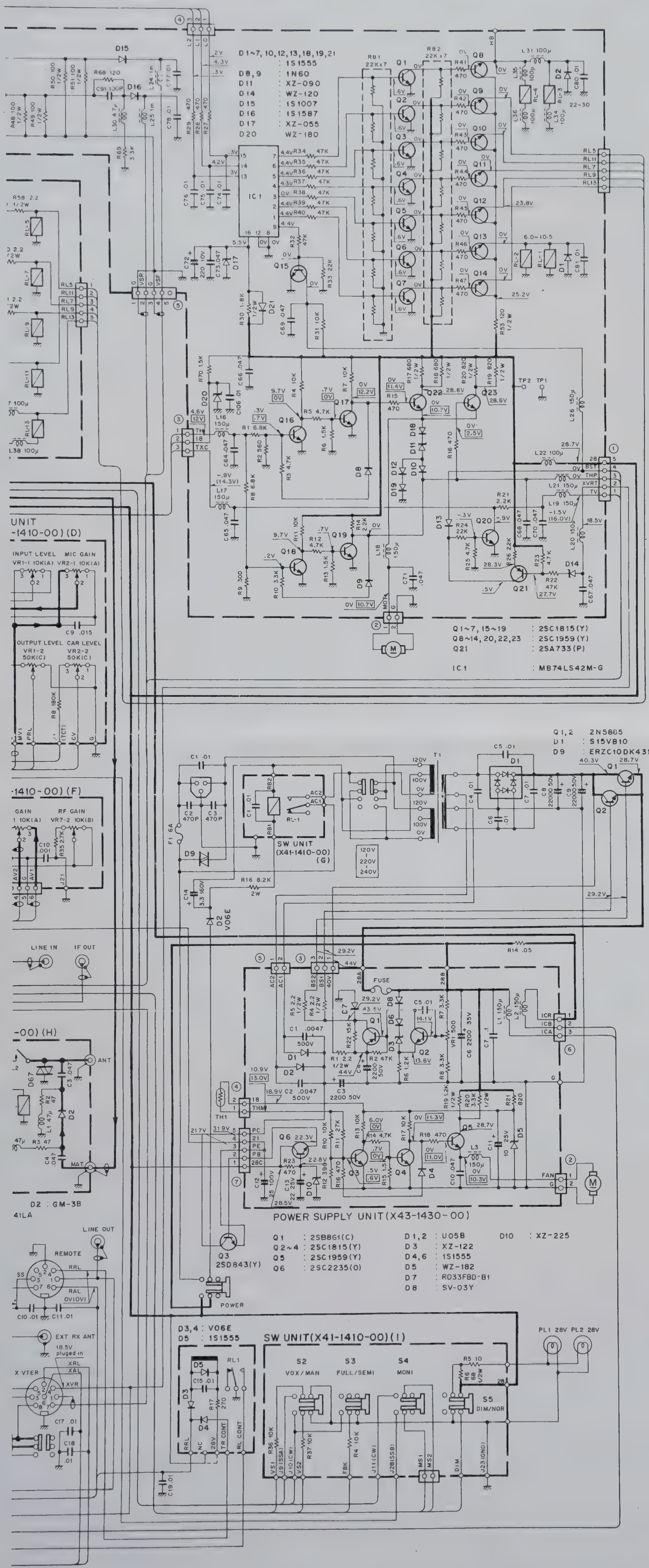
A
B
C
D
E
F
2
3
4
5
6
7
8
9
10
RF UNIT(X44-1490-00)
Q1,2 : 2SK125P
Q3,4 : 2SK125
Q5 : 2SC2053
IF TRAP
FINAL UNIT(X56-1430-00)
Q1 : 2SC2075
Q2,3 : MRF485
Q4,5 : MRF422
Q6,8 : 2SC496(Y)
Q7 : 2SD880(Y)
Q9 : 2SC1959(Y)
IC1 : MC1723CL
D1 : BZ-350
D2,4 : STV3H(O)
D3 : 1S1555
D5 : BZ-192
DRIVE BIAS
SW UNIT(X41-1410-00)(O)
DISPLAY
V1 : 11-BT-03Z
DIGITAL UNIT(X54-1670-00)
AT UNIT (X57-1010-00)
ANT
MAT
FSK KEY
PLL UNIT(X50-1880-00)
VCO
HET
D6~8 : CZ-078
RIT ENCODER UNIT (X54-1690-00)
MAIN ENCODER UNIT (X54-1680-00)
BATTERY 1.5V x 3
SW UNIT (X41-1410-00)(J)
MIC
SW UNIT (X41-1410-00)(K)
CAL S38
VOX GAIN
ANTI
DELAY
SW UNIT(X41-1410-00)(M)
S17 A=B
S18 VFO/MEMO
S19 M▸IN
S20 MR
S21 NB1
S22 NB2
D38~49 : 1S1555
S23 FUNCTION
S24 M CH
S25 RF ATT
NB LEVEL VR8 300(B)
S11 T-F SET
S12 RIT
S13 RIT-CL
S14 NOTCH
S15 AF TUNE
S16 D-LOCK
D36,37 : 1S1555
SW UNIT(X41-1410-00)(N)
SW UNIT (X41-1410-00)(L)
S26 UP
S27 DOWN
D50~65 : 1S1555
PHONE
KEY
EXT SP
SP

— Common DC Line

The voltages measured when receiving 14.175MHz, USI


G
H
I
K
LPF UNIT(X51-1280-00)
SW UNIT (X41-1410-00)(A)
SW UNIT (X41-1410-00)(B)
D3 : BG5532K
D4,5 : PR5532K
Q1~4 : 2SC1815(Y) D14~26,31,32,66,101,102 : 1S1555
Q5 : 2SA1015(Y) D35 : XZ-060
SW UNIT (X41-1410-00)(C) D6~13,100 : 1S1555
SW UNIT (X41-1410-00)(D)
(X41-1410-00)(E)
SW UNIT(X41-1410-00)(F)
SW UNIT (X41-1410-00)(G)
SW UNIT (X41-1410-00)(H)
D1 : 1S1555 D2 : GM-3B
D67 : D5A-441LA
SIGNAL UNIT(X57-1000-11)
POWER SUPPLY UNIT(
Q1 : 2SB861(C)
Q2~4 : 2SC1815(Y)
Q5 : 2SC1959(Y)
Q6 : 2SC2235(O)
D3,4 : V06E
D5 : 1S1555
SW UNIT(X41-1410-00)
S2 VOX/MAN
S3 FULL/SEMI
D1~7,10,12,13,18,19,21 : 1S1555
D8,9 : 1N60
D11 : XZ-090
D14 : WZ-120
D15 : 1S1007
D16 : 1S1587
D17 : XZ-055
D20 : WZ-180
LINE IN
IF OUT
LINE OUT
REMOTE
EXT RX ANT
X.VTER
POWER
ANT
120V 220V 240V

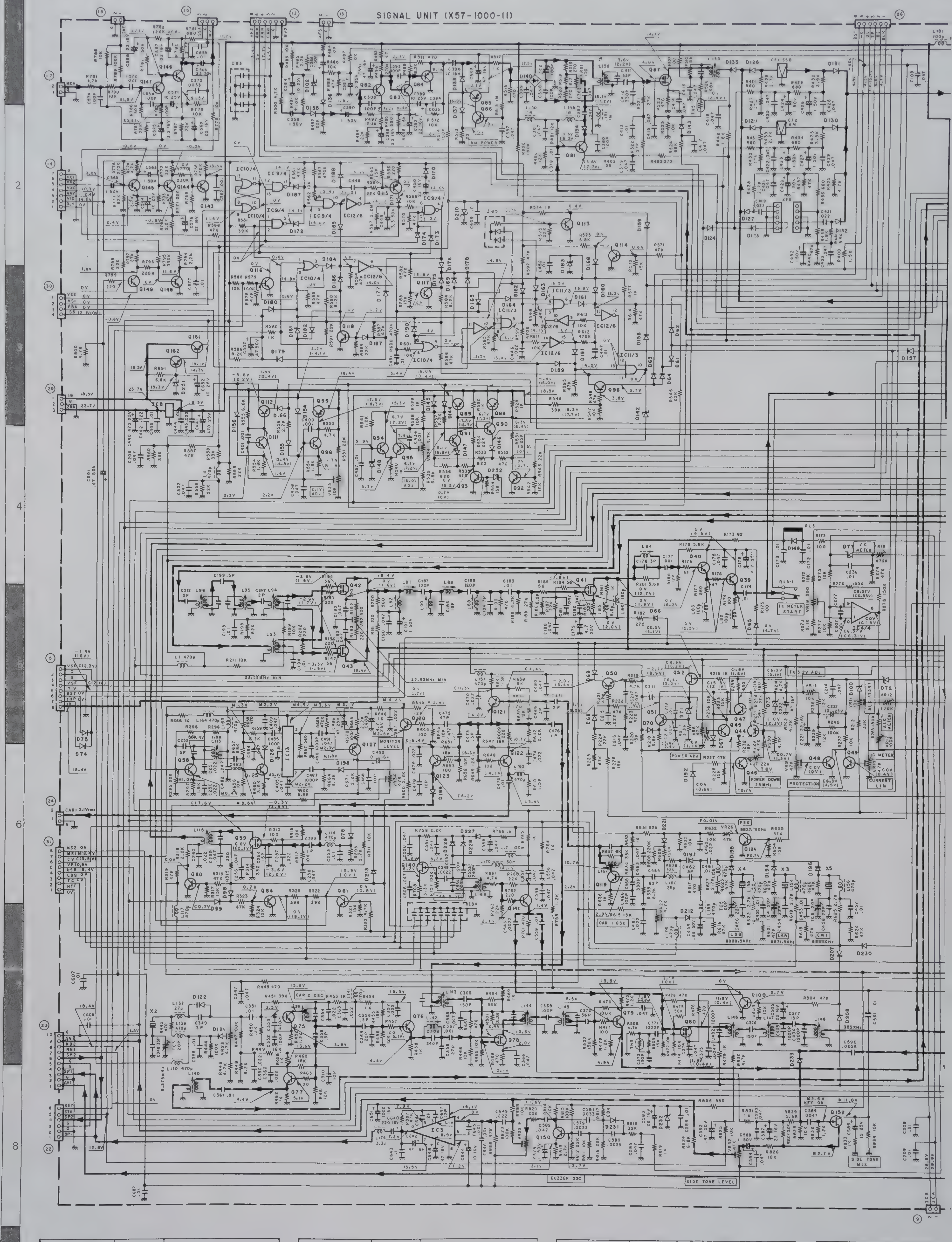
The voltages measured when receiving 14.175MHz, USB MODE. ( ) : in TX, ▭: Thermal protection ON.


D1~7, 10, 12, 13, 18, 19, 21 : 1S1555
D8, 9 : 1N60
D11 : XZ-090
D14 : WZ-120
D15 : 1S1007
D16 : 1S1587
D17 : XZ-055
D20 : WZ-180
IC1
Q1~7, 15~19 : 2SC1815(Y)
Q8~14, 20, 22, 23 : 2SC1959(Y)
Q21 : 2SA733(P)
IC1 : MB74LS42M-G
RL5
RL11
RL7
RL9
RL13
BST
THP
XVRT
TV
TP2 TP1
UNIT
-1410-00) (D)
INPUT LEVEL VR1-1 10K(A)
MIC GAIN VR2-1 10K(A)
OUTPUT LEVEL VR1-2 50K(C)
CAR LEVEL VR2-2 50K(C)
-1410-00) (F)
GAIN
RF GAIN VR7-2 10K(B)
LINE IN
IF OUT
-00) (H)
ANT
D2 : GM-3B
41LA
LINE OUT
REMOTE
EXT RX ANT
18.5V pluged in
X VTER
Q1, 2 2N5885
D1 : S15VB10
D9 : ERZC10DK431
SW UNIT (X41-1410-00) (G)
120V 220V 240V
F1 6A
D2 V06E
FUSE
TH1
POWER SUPPLY UNIT(X43-1430-00)
Q1 : 2SB861(C)
Q2~4 : 2SC1815(Y)
Q5 : 2SC1959(Y)
Q6 : 2SC2235(O)
D1, 2 : U05B
D3 : XZ-122
D4, 6 : 1S1555
D5 : WZ-182
D7 : RD33FBD-B1
D8 : SV-03Y
D10 : XZ-225
Q3 2SD843(Y)
POWER
FAN
D3, 4 : V06E
D5 : 1S1555
SW UNIT(X41-1410-00)(I)
S2 VOX/MAN
S3 FULL/SEMI
S4 MONI
S5 DIM/NOR
PL1 28V PL2 28V
RL1

TS-930S SIGNAL UNIT (X57-1000-11)

From S/N310XXXX–

Signal Line — Control Line


SIGNAL UNIT (X57-1000-11)
MONITOR LEVEL
CAR 2 OSC
CAR 1 OSC
POWER ADJ
POWER DOWN 28MHz
PROTECTION
IC METER
CURRENT LIM
ALC METER
ALC START
TX 3.2V ADJ
IC METER START
VC METER
23.85MHz MIX
FSK
LSB
USB
BUZZER OSC
SIDE TONE LEVEL
SIDE TONE MIX

Terminals No.		Terminals Name	Colro	Destination
①	1	AT1	YEL	SW (M)
	2	AT2	BLU	
2	1	MKR	GRY	PLL unit ⑥
	2	G		
3	1	PL5	GRN	PLL unit ②
	2	AT4	BLU	PLL unit ①
	3	ABO	–	–
4	1	RB3	YEL	Digital unit ⑪
	2	RB2	WHT/GRN	
	3	RB1	WHT/VIO	
	4	RB0	WHT/BLU	
5	1	VSR	ORG	LPF unit ⑤
	2	G		
	3	G		
	4	VSF	RED	
	5	TV	GRN	LPF unit ①
	6	BST	ORG	
	7	THP	YEL	
	8	18	RED	Final unit ①

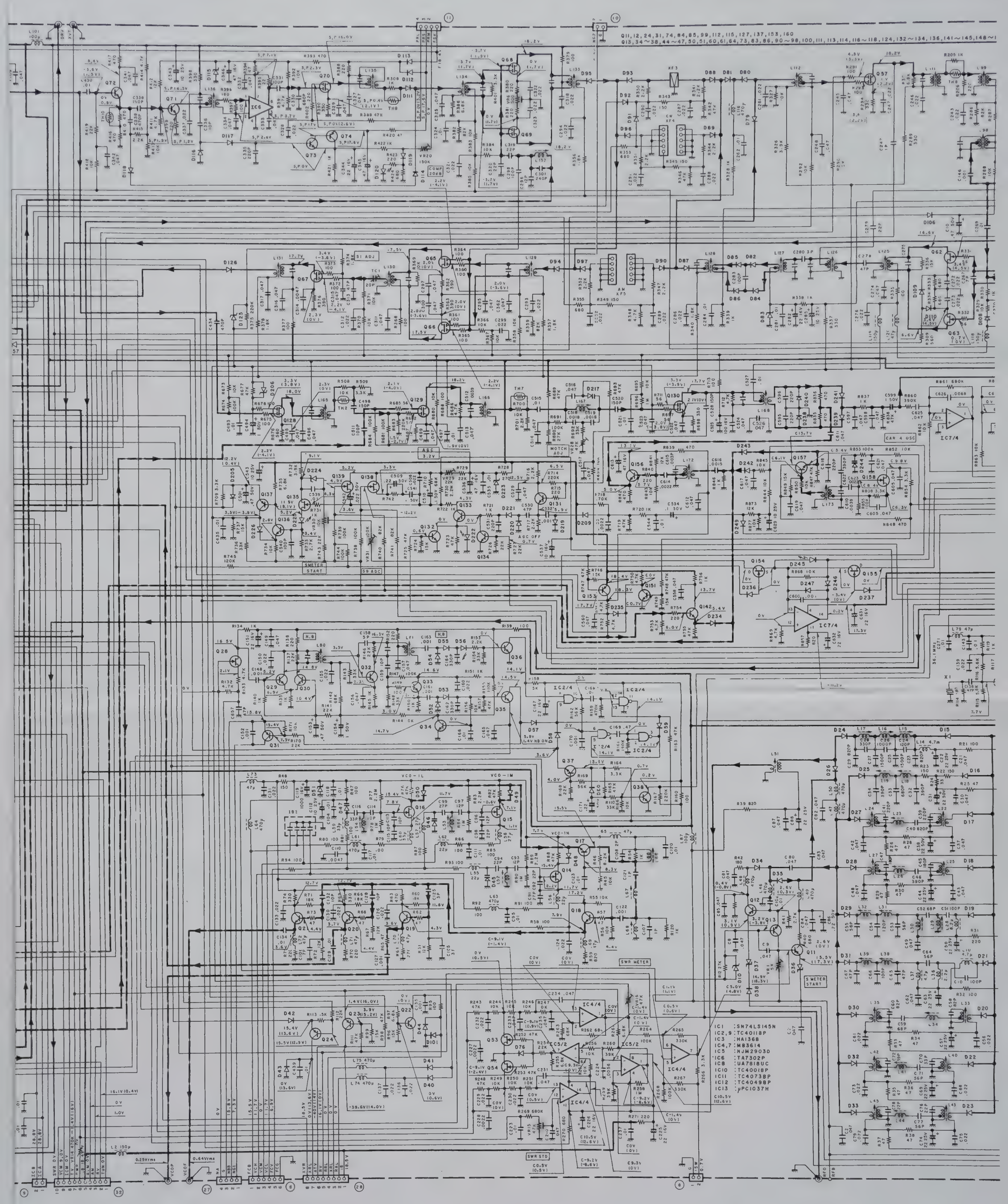
Terminals No		Terminals Name	Color	Destination
⑥	1	FCB	BRN	PLL unit ①
	2	VCH	RED	PLL unit ③
	3	VCM	ORG	
	4	VCL	YEL	
	5	FCV	RED	PLL unit ①
	6	FCG		
⑦	1	NA	GRY	Signal unit ㉗
	2	G		
	3	NBB		
	4	NG1	GRY	
⑧	1	G		
	2	ISW	BLU	AT unit ②
⑨	1	ICA	BRN	Power supply unit ⑥
	2	ICB	WHT	
⑩	1	NG2	YEL	Signal unit ㉕
	2	G		
⑪	1	FSK	WHT	SW (A) MODE SW S10-1
	2	PRM	BRN	SW (E) METER SW
	3	PRS	ORG	SW (C)
	4	PRL	YEL	SW (D) VR1-2

Terminals No		Terminals Name	Color	Destination
12	1	MV2	BLU	SW (C) PRO SW S8
	2	G		
	3	CWN	RED	SW (C)
	4	AMN	ORG	
	5	AMW	YEL	
	6	VF2	GRN	SW (A)
13	1	G		PLL unit ⑤ 3
	2	AFS	RED	PLL unit ⑤ 4
14	1	DLY	GRY	SW (K)
	2	V12	VIO	
	3	ANV	BRN	
	4	VXC	WHT	
	5	VX2	RED	
	6	VX1	BLU	
	7	G		
15	1	MV1	RED	SW (D) VR1-1
	2	G		
	3	SSA	BRN	SW(A)
16	1	G		
	2	MCL	BLU	SW (J)

Termianls No.		Termianls Name	Color
17	1	G	
	2	MCH	–
18	1	LINE	BLU
	2	G	
⑲	1	AGO	VIO
	2	RFG	YEL
	3	NTH	ORG
	4	NAM	WHT
	5	AGS	GRY
⑳	1	G	
	2	IFO	GRY
㉑	1	AM	VIO
	2	CW	GRY
	3	CWP	WHT
	4	AP5	BRN
	5	AP4	RED
	6	AP2	ORG
	7	AP3	GRN
	8	AP1	YEL
	9	M	BLU
	10	TM	WHT/BRN
	11	AP0	WHT/RED

l Line ——— Common DC Line

The voltages measured when receiving 14.175MHz, SSB MODE,
C : CW MODE, 100W OUTPUT, F : FSK MODE, M : MONITO


Q11, 12, 24, 31, 74, 84, 85, 99, 112, 115, 127, 137, 153, 160
Q13, 34～38, 44～47, 50, 51, 60, 61, 64, 73, 83, 86, 90～98, 100, 111, 113, 114, 116～118, 124, 132～134, 136, 141～145, 148～1
IC1 :SN74LS145N
IC2,9 :TC4011BP
IC3 :HA1368
IC4,7 :MB3614
IC5 :NJM2903D
IC6 :TA7302P
IC8 :UA7818UC
IC10 :TC4001BP
IC11 :TC4073BP
IC12 :TC4049BP
IC13 :μPC1037H
COMP 2068
SMETER START
S9 ADC
SWR METER
SWR STD
CAR 4 OSC
AGC OFF
MOTCH ADJ
VCO-IL
VCO-IM
VCO-IH
VCOP
VCOF
RFO
RFB
0.25Vrms
0.64Vrms
L2 150μ

olor	Destination
	—
J	LINE IN jack
D	SW (E)
L	SW (F)
G	SW (F)
T	SW (E)
Y	SW (E)
Y	IF OUT terminal
D	SW (A)
Y	SW (A)
T	SW (A)
N	SW (N)
D	SW (A)
G	
N	
L	
U	METER
T/BRN	SW (E)
T/RED	SW (N)

Terminals			Color	Destination
No		Name		
22	1	SP1	RED	LINE OUT terminal
	2	G		
	3	G		
	4	SP2	ORG	EXT. SP jack
	5	STK	VIO	KEY jack
	6	KEY	GRY	KEY jack
23	1	AV1	RED	SW (F)
	2	G		
	3	SP1	ORG	PHONE jack
	4	G		
	5	G		
	6	SP2	YEL	PHONE jack
	7	NB1	GRN	SW (M) NB2 SW
	8	NB2	BLU	
	9	AV2	BLU	SW (F)
	10	G		
24	1	G		
	2	CAR1	GRY	PLL unit 8
25	1	NG2	YEL	Signal unit 10
	2	G		

Terminals			Color	Destination
No		Name		
26	1	BLK	GRN	Digital unit 2
	2	BZ	BLU	
	3	TR	VIO	
	4	UL	GRY	
	5	−C	WHT	
	6	DST	BRN	
27	1	NA	GRY	Signal unit 7
	2	G		
	3	NBB		
	4	NG1	GRY	
28	1	18	—	
	2	RAL	WHT	REMOTE socket
	3	XAL	BRN	X. VTER socket
	4	RRL	VIO	REMOTE socket
	5	RV	ORG	SW (H)
	6	ATV	YEL	SW (H)
	7	XGL	GRN	X. VTER socket
	8	XVR	BLU	X. VTER socket
29	1	18	—	—
	2	G		
	3	28A	YEL	R1 – R3 27Ω 2W

Terminals			Color	Destination
No		Name		
30	1	VS2	YEL	SW (I) VOX/MAN SW S2
	2	VS1	GRN	SW (I) VOX/MAN SW S2
	3	FBK	BLU	SW (I) FULL/SEMI SW S3
	4	SS	VIO	SW (C) STBY SW S6
31	1	NTF	WHT.	SW (A)
	2	TC	GRY	SW (A)
	3	LSB	VIO	SW (A)
	4	USB	BLU	SW (A)
	5	VF1	GRN	SW (A) MODE SW S10-5
	6	CV	YEL	SW (D) VR2-2
	7	MS1	ORG	SW (I) MONI SW S4
	8	MS2	BRN	SW (I) MONI SW S4
32	1	TUN	BRN	SW (A) MODE SW S10-1
	2	RV	GRN	SW (A) MODE SW S10-4
	3	AM	ORG	SW (A) MODE SW S10-1
	4	ALM	YEL	SW (E)
	5	18	RED	SW (A) MODE SW S10-3
	6	PWR	BLU	SW (E)
	7	TV	VIO	SW (A) MODE SW S10-2
	8	ICM	GRY	SW (E)
	9	VCM	WHT	
	10	SWR	BRN/WHT	

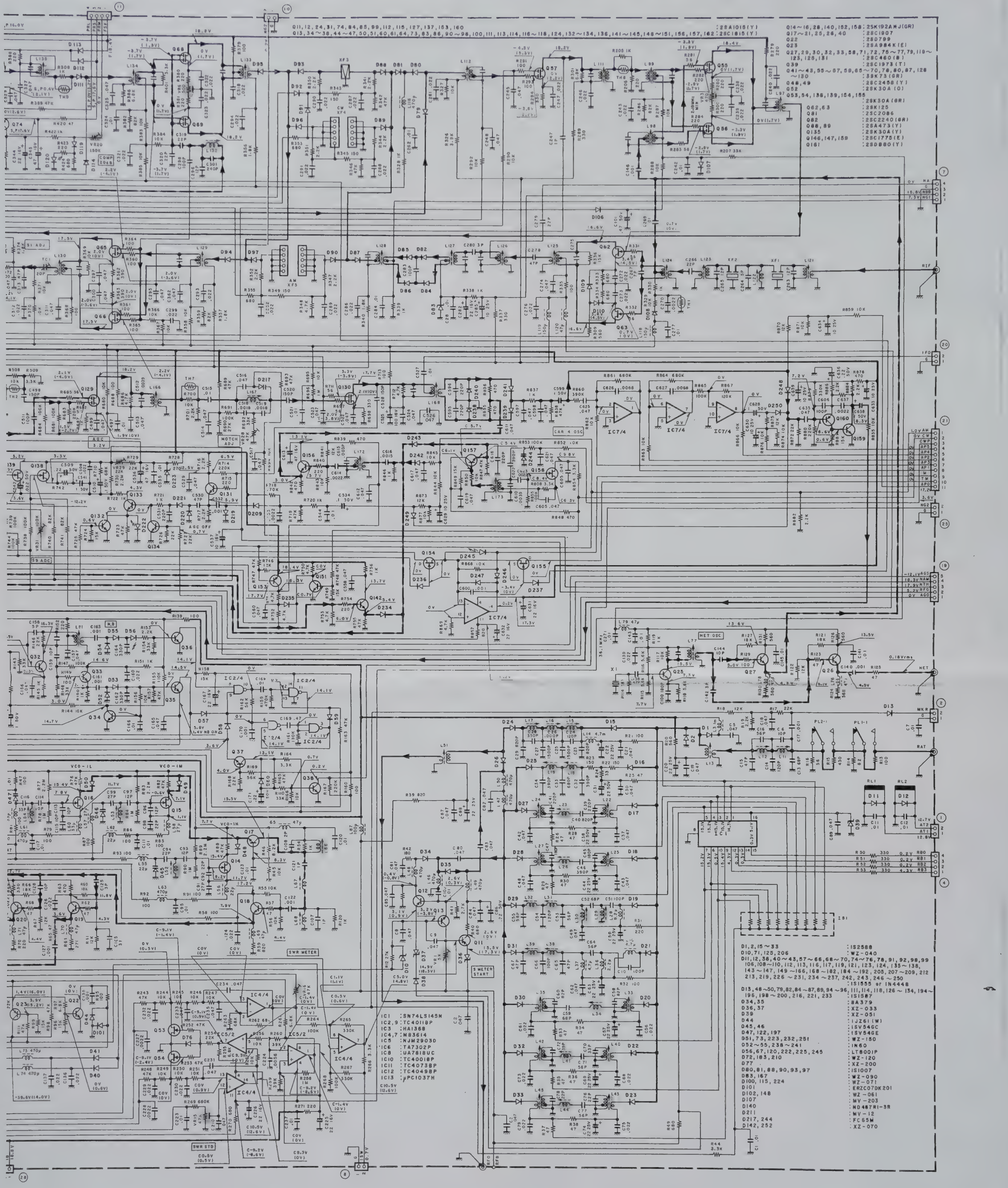
Terminal name	Col
VCOP	BL
VCOF	GR
RFO (FRO)	GR
RAT	GR
HET	BL
RIF	GR
XVT	GR
DRV	GR

RED	RE
ORG	OF
VIO	VI
GRY	GF
WHT	WH
YEL	YE
BLU	BL
BRN	BR
GRN	GF
BLK	BL

3

I J K L M N

The voltages measured when receiving 14.175MHz, SSB MODE, RF GAIN : MAX. ( ) : in TX.
C : CW MODE, 100W OUTPUT, F : FSK MODE, M : MONITOR ON, T : TUNE MODE, S, P : SSB MODE, PROCESSOR ON


Q11,12,24,31,74,84,85,99,112,115,127,137,153,160 :2SA1015(Y)
Q13,34~38,44~47,50,51,60,61,64,73,83,86,90~98,100,111,113,114,116~118,124,132~134,136,141~145,148~151,156,157,162 :2SC1815(Y)
Q14~16,28,140,152,158 :2SK192AMJ(GR)
Q17~21,25,26,40 :2SC1907
Q22 :2SD799
Q23 :2SA984K(E)
Q27,29,30,32,33,58,71,72,75~77,79,119~123,125,131 :2SC460(B)
Q39 :2SC1973(T)
Q41~43,55~57,59,65~70,78,80,87,128~130 :3SK73(GR)
Q48,49 :2SC2458(Y)
Q52 :2SK30A(O)
Q53,54,138,139,154,155 :2SK30A(GR)
Q62,63 :2SK125
Q81 :2SC2086
Q82 :2SC2240(GR)
Q88,89 :2SA473(Y)
Q135 :2SK30A(Y)
Q146,147,159 :2SC1775(E)
Q161 :2SD880(Y)
IC1 :SN74LS145N
IC2,9 :TC4011BP
IC3 :HA1368
IC4,7 :MB3614
IC5 :NJM2903D
IC6 :TA7302P
IC8 :UA7818UC
IC10 :TC40018P
IC11 :TC4073BP
IC12 :TC4049BP
IC13 :μPC1037H
D1,2,15~33 :1S2588
D10,71,125,206 :WZ-040
D11,12,38,40~43,57~66,68~70,74~76,78,91,92,98,99 106,108~110,112,113,116,117,119,121,123,124,135~138, 143~147,149~166,168~182,184~192,205,207~209,212 213,219,226~231,234~237,242,243,246~250 :1S1555 or 1N4448
D13,48~50,79,82,84~87,89,94~96,111,114,118,126~134,194~196,198~200,216,221,233 :1S1587
D34,35 :BA379
D36,37 :XZ-033
D39 :XZ-051
D44 :1JZ61(W)
D45,46 :1SV54GC
D47,122,197 :1SV54GE
D51,73,223,232,251 :WZ-150
D52~55,238~241 :1N60
D56,67,120,222,225,245 :LT8001P
D72,183,210 :WZ-120
D77 :XZ-200
D80,81,88,90,93,97 :1S1007
D83,167 :WZ-090
D100,115,224 :WZ-071
D101 :ERZC07DK201
D102,148 :WZ-061
D107 :MV-203
D140 :ND487R1-3R
D211 :MV-12
D217,244 :FC65M
D142,252 :XZ-070
SWR METER
S METER START
SWR STD
HET OSC
CAR 4 OSC
NOTCH ADJ
AGC OFF
VCO-1L
VCO-1M
VCO-1H
RIF
HET
IFO
MKR
RAT
RFO
RFB

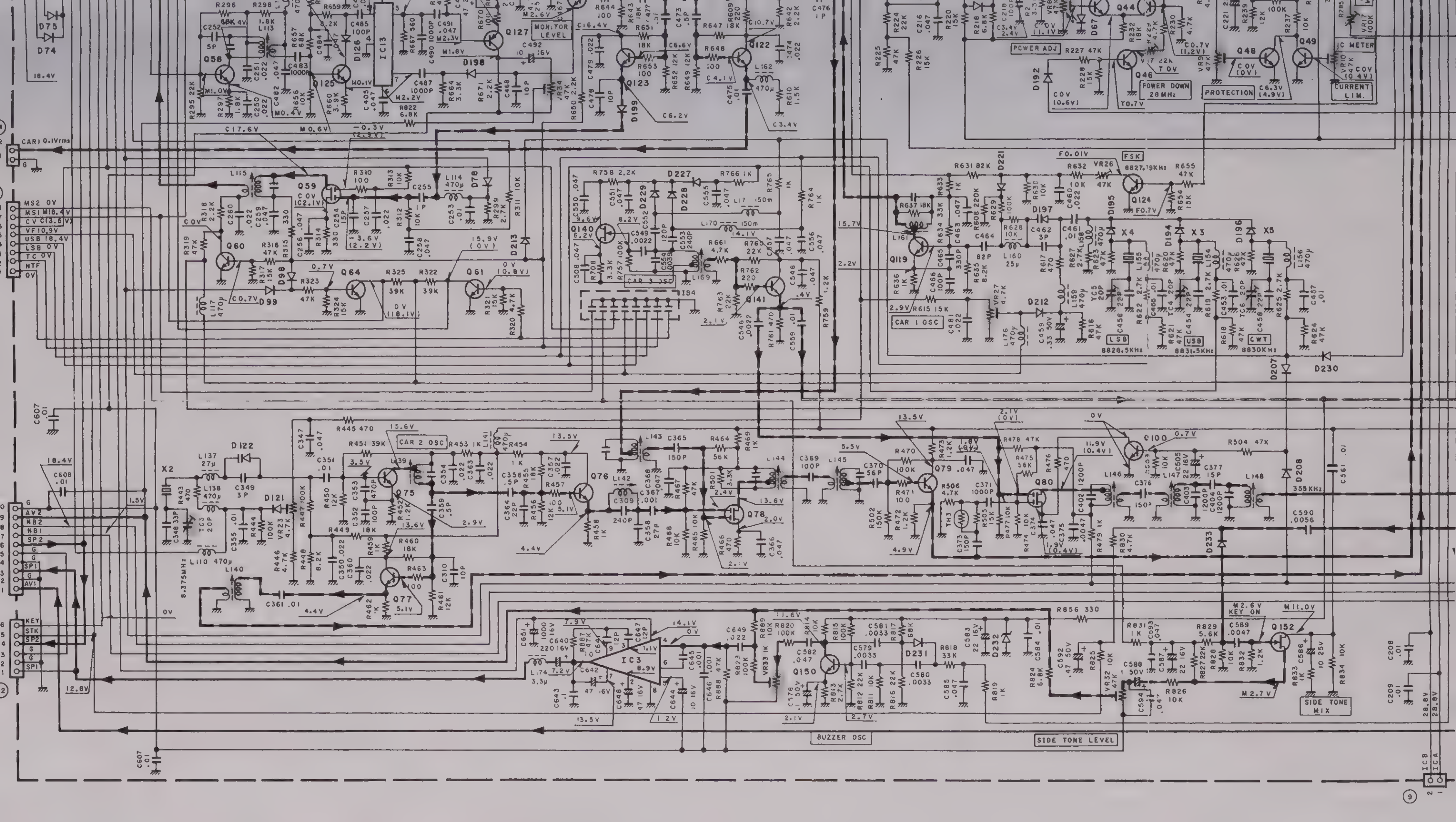
tination
terminal
ck
k
k
IB2 SW
10

Terminals		Color	Destination
No.	Name		
26 1	BLK	GRN	Digital unit 2
2	BZ	BLU	
3	TR	VIO	
4	UL	GRY	
5	–C	WHT	
6	DST	BRN	
27 1	NA	GRY	Signal unit 7
2	G		
3	NBB		
4	NG1	GRY	
28 1	18	–	
2	RAL	WHT	REMOTE socket
3	XAL	BRN	X. VTER socket
4	RRL	VIO	REMOTE socket
5	RV	ORG	SW (H)
6	ATV	YEL	SW (H)
7	XGL	GRN	X. VTER socket
8	XVR	BLU	X. VTER socket
29 1	18	–	–
2	G		
3	28A	YEL	R1 – R3 27Ω 2W

Terminals		Color	Destination
No.	Name		
30 1	VS2	YEL	SW (I) VOX/MAN SW S2
2	VS1	GRN	SW (I) VOX/MAN SW S2
3	FBK	BLU	SW (I) FULL/SEMI SW S3
4	SS	VIO	SW (C) STBY SW S6
31 1	NTF	WHT	SW (A)
2	TC	GRY	SW (A)
3	LSB	VIO	SW (A)
4	USB	BLU	SW (A)
5	VF1	GRN	SW (A) MODE SW S10-5
6	CV	YEL	SW (D) VR2-2
7	MS1	ORG	SW (I) MONI SW S4
8	MS2	BRN	SW (I) MONI SW S4
32 1	TUN	BRN	SW (A) MODE SW S10-1
2	RV	GRN	SW (A) MODE SW S10-4
3	AM	ORG	SW (A) MODE SW S10-1
4	ALM	YEL	SW (E)
5	18	RED	SW (A) MODE SW S10-3
6	PWR	BLU	SW (E)
7	TV	VIO	SW (A) MODE SW S10-2
8	ICM	GRY	SW (E)
9	VCM	WHT	
10	SWR	BRN/WHT	

Terminal name	Color	Destination
VCOP	BLK	PLL unit "VCO"
VCOF	GRY	RF unit "VCOF"
RFO (FRO)	GRY	RF unit "RFO"
RAT	GRY	X. VTER jack SW
HET	BLK	PLL unit "HET"
RIF	GRY	RF unit "RIF"
XVT	GRY	X. VTER jack
DRV	GRY	Final unit "IN"

RED	RED
ORG	ORANGE
VIO	VIOLET
GRY	GRAY
WHT	WHITE
YEL	YELLOW
BLU	BLUE
BRN	BROWN
GRN	GREEN
BLK	BLACK


6
8
10
CAR 2 OSC
CAR 3 OSC
CAR 1 OSC
BUZZER OSC
SIDE TONE LEVEL
SIDE TONE MIX
MONITOR LEVEL
POWER ADJ
POWER DOWN 28MHz
PROTECTION
CURRENT LIM.
IC METER
FSK 8827.19KHz
LSB 8828.5KHz
USB 8831.5KHz
CWT 8830KHz
KEY ON
IC3
IC13
8.375MHz
355KHz
CAR1 0.1Vrms
MS2 0V
MS1 M18.4V
CV C13.5V
VF10.9V
USB 18.4V
LSB 0V
TC 0V
NTF
0V
G
AV2
NB2
NB1
SP2
SP1
AV1
KEY
STK
ICB
ICA
28.8V
12.8V
18.4V
Q58
Q59
Q60
Q61
Q64
Q75
Q76
Q77
Q78
Q79
Q80
Q100
Q119
Q122
Q123
Q124
Q125
Q127
Q140
Q141
Q150
Q152
Q44
Q46
Q48
Q49
X2
X3
X4
X5
D74
D75
D78
D98
D99
D121
D122
D126
D192
D194
D195
D196
D197
D198
D199
D207
D208
D212
D213
D221
D227
D228
D229
D230
D231
D232
D233
D67
TH1
VR23
VR26
VR27
VR32
VR33
VR34
VR9
VR10
VR17
TC3
TC4
TC5
TC6
(22)
(23)
(24)
(31)
(9)

Terminals			Colro	Destination
No.		Name		
1	1	AT1	YEL	SW (M)
	2	AT2	BLU	
②	1	MKR	GRY	PLL unit ⑥
	2	G		
3	1	PL5	GRN	PLL unit 2
	2	AT4	BLU	PLL unit 1
	3	ABO	–	–
4	1	RB3	YEL	Digital unit 11
	2	RB2	WHT/GRN	
	3	RB1	WHT/VIO	
	4	RB0	WHT/BLU	
5	1	VSR	ORG	LPF unit 5
	2	G		
	3	G		
	4	VSF	RED	
	5	TV	GRN	LPF unit 1
	6	BST	ORG	
	7	THP	YEL	
	8	18	RED	Final unit 1

Terminals			Color	Destination
No.		Name		
6	1	FCB	BRN	PLL unit 1
	2	VCH	RED	PLL unit 3
	3	VCM	ORG	
	4	VCL	YEL	
	5	FCV	RED	PLL unit 1
	6	FCG		
7	1	NA	GRY	Signal unit 27
	2	G		
	3	NBB		
	4	NG1	GRY	
8	1	G		
	2	ISW	BLU	AT unit ②
9	1	ICA	BRN	Power supply unit ⑥
	2	ICB	WHT	
⑩	1	NG2	YEL	Signal unit ㉕
	2	G		
11	1	FSK	WHT	SW (A) MODE SW S10-1
	2	PRM	BRN	SW (E) METER SW
	3	PRS	ORG	SW (C)
	4	PRL	YEL	SW (D) VR1-2

Terminals			Color	Destination
No.		Name		
12	1	MV2	BLU	SW (C) PRO SW S8
	2	G		
	3	CWN	RED	SW (C)
	4	AMN	ORG	
	5	AMW	YEL	
	6	VF2	GRN	SW (A)
13	1	G		PLL unit 5, 3
	2	AFS	RED	PLL unit 5, 4
14	1	DLY	GRY	SW (K)
	2	V12	VIO	
	3	ANV	BRN	
	4	VXC	WHT	
	5	VX2	RED	
	6	VX1	BLU	
	7	G		
15	1	MV1	RED	SW (D) VR1-1
	2	G		
	3	SSA	BRN	SW(A)
16	1	G		
	2	MCL	BLU	SW (J)

Termianls			Color
No.		Name	
17	1	G	
	2	MCH	–
18	1	LINE	BLU
	2	G	
19	1	AGO	VIO
	2	RFG	YEL
	3	NTH	ORG
	4	NAM	WHT
	5	AGS	GRY
⑳	1	G	
	2	IFO	GRY
21	1	AM	VIO
	2	CW	GRY
	3	CWP	WHT
	4	AP5	BRN
	5	AP4	RED
	6	AP2	ORG
	7	AP3	GRN
	8	AP1	YEL
	9	M	BLU
	10	TM	WHT/BRN
	11	AP0	WHT/RED

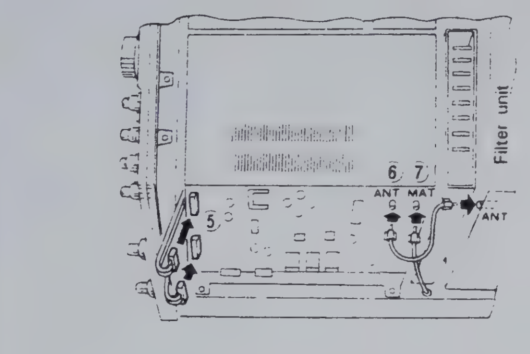
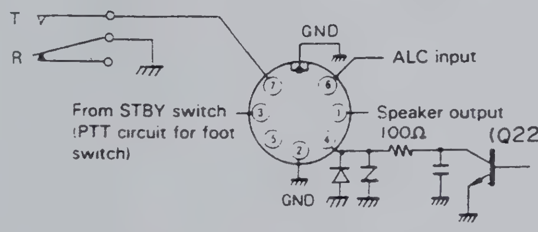

Filter unit
6
7
ANT
MAT
ANT
5
⑤, ⑥, ⑦

Fig. 6-2C

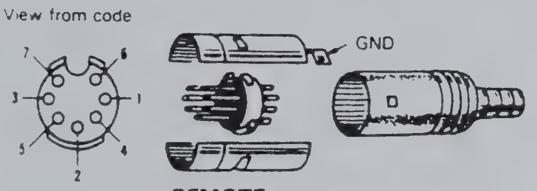
6.5 REMOTE CONTROL WIRING

Fig. 6-3 shows the REMOTE connector. This 7 pin DIN plug can be used to control a linear amplifier or other external accessories.
Kenwood linear amplifier TL-922 can be connected to this unit with its remote cable. However, when a linear amplifier other than the TL-922(A) is used, change the connection as shown in Fig. 6-4.
This allows remote operation with the relay connected to the terminal 7 of the DIN jack.

NOTE:
ALWAYS use shielded line for all connections.


T
R
GND
ALC input
From STBY switch
(PTT circuit for foot switch)
Speaker output
100Ω
(Q22)
GND

TS-930S Internal Wiring


View from code
7
6
3
1
5
4
2
GND

REMOTE connector

Fig. 6-3 REMOTE connector

PIN	FUNCTION	PIN	FUNCTION
1	Speaker output	5	No connection
2	Ground	6	ALC input ALC threshold level approx. −6 V
3	PTT line	7	Normally opened, closed in trasmit See Fig. 6-3.
4	Normally opened, closed in transmit		

Table 6-2

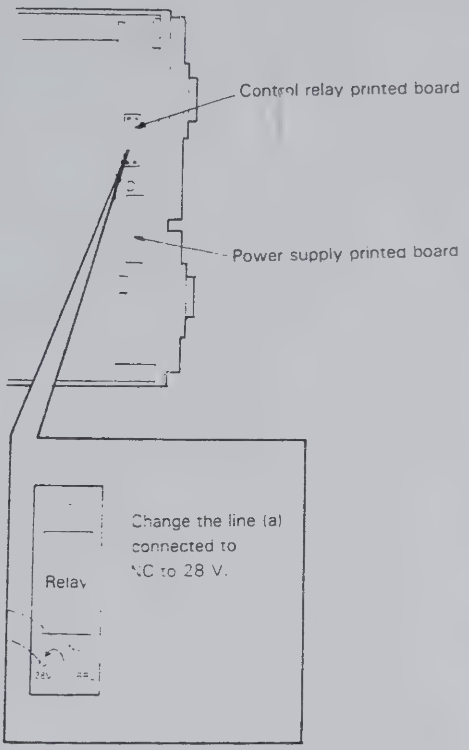

Control relay printed board
Power supply printed board
Change the line (a) connected to NC to 28 V.
Relay

Fig. 6-4

■ OPERATION WITH A LINEAR AMPLIFIER

The TS-930S may be operated with any conventional linear amplifier which will accept up to approximately 125 watts RF drive, has a low current DC operated keying circuit, and returns approximately −8 ~ −10 V DC ALC (adjustable) back to the exciter. Please note that in order to operate QSK (full break-in), the linear amplifier must also be QSK capable.

For operation with a linear amplifier, refer to Fig. 6-3, TS-930S internal wiring.
Pin 6 ALC input
Pin 2 Ground
Pin 4 Control line center conductor
Use shielded line for both ALC and RL (control line).

Initial linear amplifier tune-up should be performed with the exciter in the tune mode, to reduce wear-and-tear on both the linear, and the exciter. Use of a dummy load is strongly suggested, since the bands are already sufficiently crowded.

■ SSTV OR AFSK OPERATION

The TS-930S will adapt to slow scan television AFSK or RTTY operation (besides the built-in FSK mode). For SSTV, the only cabling required are connections between the transceiver phone patch input and the camera output, and between the patch output and the monitor input.

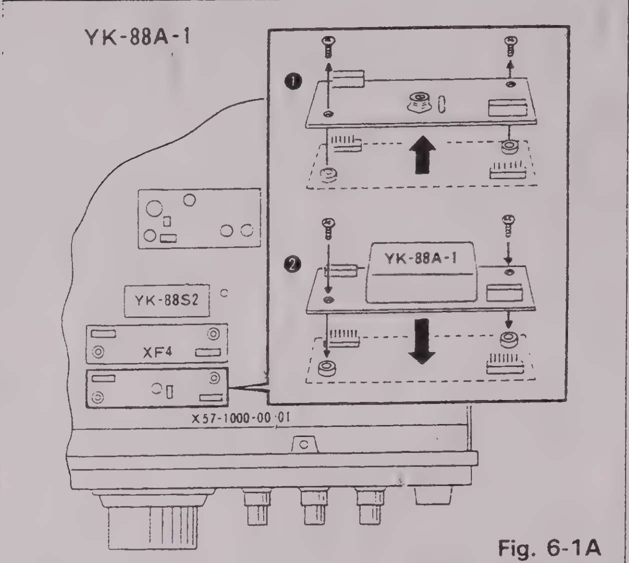

YK-88A-1
❶
❷
YK-88A-1
YK-88S2
XF4
X57-1000-00 01

Fig. 6-1A

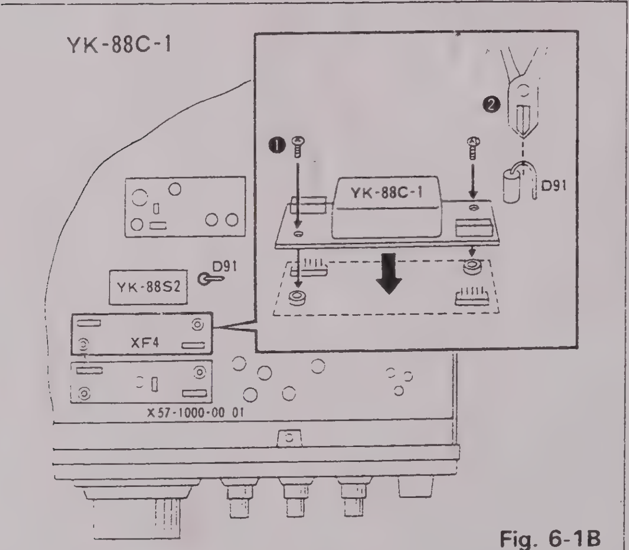

YK-88C-1
❶
❷
YK-88C-1
D91
YK-88S2
D91
XF4
X57-1000-00 01

Fig. 6-1B

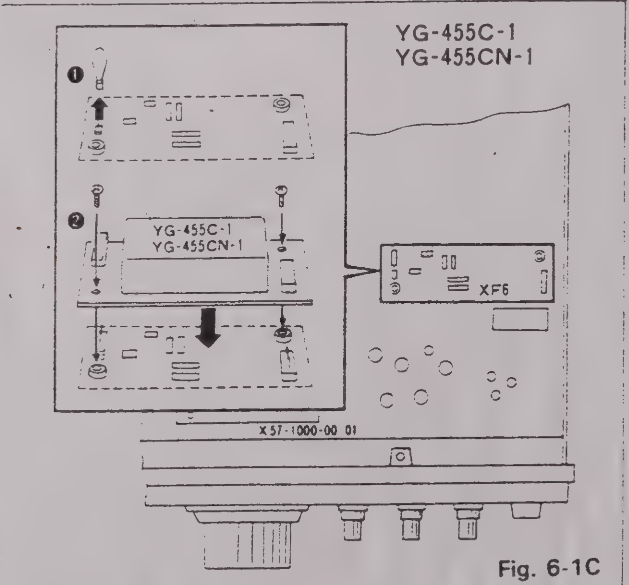

YG-455C-1
YG-455CN-1
❶
❷
YG-455C-1
YG-455CN-1
XF6
X57-1000-00 01

Fig. 6-1C

6.4 AT-930 INSTALLATION

(1) Remove the top and bottom covers (16 screws, total) from the transceiver.

(2) Remove the 4 screws and cable retainers located in the AT-930 mounting space.

(3) Using a long-nosed plier, carefully disconnect the coaxial cable from the filter unit ANT terminal

CAUTION:

Coax leads with connectors are not repairable. When connecting or disconnecting, do not break the male or female connectors.

(4) Secure the AT-930 to the transceiver using 4 screws.

CAUTION:

Do not pinch any leads between the AT-930 and transceiver chassis.

(5) Install the multi-connector to the AT-930.

(6) Connect the coaxial cable, which was removed from the filter unit, to the AT-930 MAT terminal.

(7) Connect the supplied coaxial cable between the AT-930 ANT terminal and the filter unit ANT terminal.

(8) Replace the transceiver top and bottom covers. The AT-930 is now ready for automatic operation.

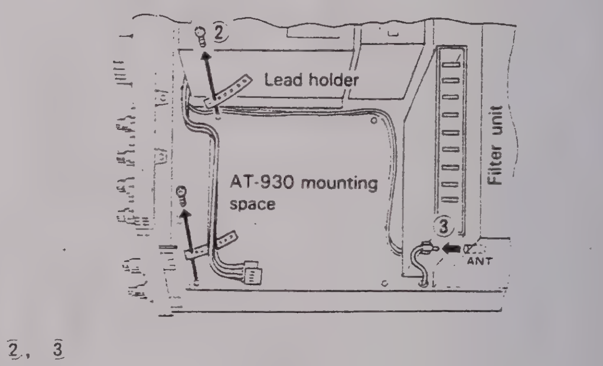

2
Lead holder
AT-930 mounting space
Filter unit
3
ANT
2, 3

Fig. 6-2A

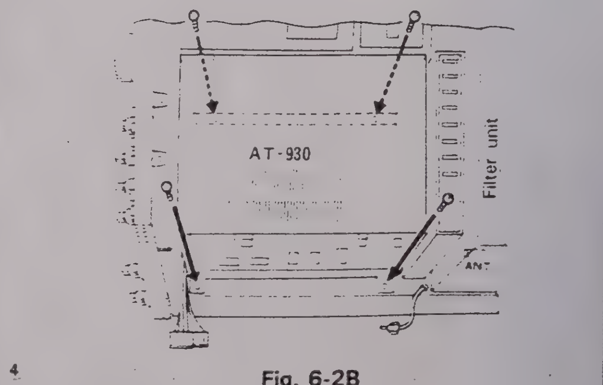

AT-930
Filter unit
ANT
4

Fig. 6-2B

SAVE ALL
This.

New reprints
needed for
schematic/
foldouts

See "G" Drive
for possibly
more info

KENWOOD

HF TRANSCEIVER

Model TS-930S

INSTRUCTION MANUAL

Model TS-930S

Serial No. ______________________

Date of Purchase ______________________

Dealer ______________________

____

____

A product of
TRIO-KENWOOD CORPORATION
17-5, 2-chome, shibuya, shibuya-ku Tokyo 150, Japan

TRIO-KENWOOD COMMUNICATIONS
1111 West Walnut Street, Compton California 90220, U.S.A.
TRIO-KENWOOD COMMUNICATIONS, GmbH
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TRIO-KENWOOD ELECTRONICS, N.V.
Leuvensesteenweg 504, B-1930 Zaventem, Belgium
TRIO-KENWOOD (AUSTRALIA) PTY. LTD.
4E Woodcock Place, Lane Cove N.S.W. 2066, Australia

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SECTION 8. MAINTENANCE AND ADJUSTMENT

GENERAL

Your TS-930S has been factory aligned and tested to specification before shipment. Under normal circumstances the transceiver will operate in accordance with these operating instructions. All adjustable trimmers and coils in your transceiver were preset at the factory and should only be readjusted by a qualified technician with proper test equipment.
Attempting service or alignment without factory authorization can void the transceivers warranty.

When operated properly, the transceiver can give years of service without requiring realignment. The information in this section gives some general service procedures which can be accomplished without sophisticated test equipment.

CLEANING

The knobs, front panel and cabinet of the TS-930S are likely to become soiled after extended use. The knobs should be removed from the transceiver and cleaned with a neutral soap and warm water. Use a neutral soap (not harsh chemicals) and damp cloth to clean the cabinet and front panel.

8.1 PREPARATION

1. Removing the covers

Remove the eight screws which fasten the top and eight screws from the bottom case panel. The covers may be lifted away.

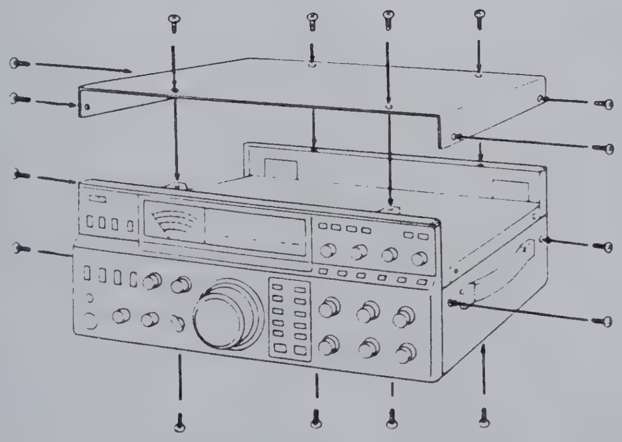


Fig. 8-1 Removing cases

2. Service position

Place the transceiver on its left side, with the final stage up, for proper ventilation.

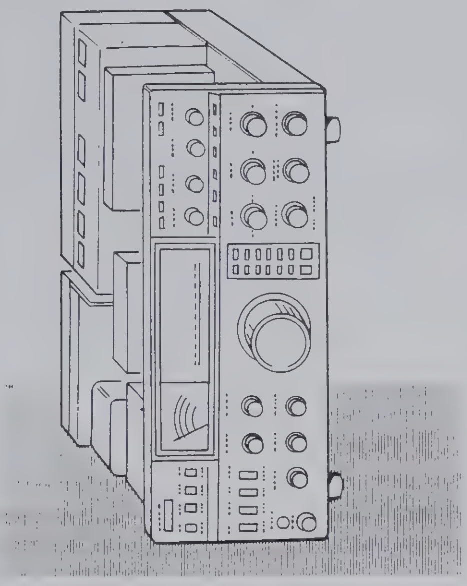


Fig. 8-2 Service position

8.2 ADJUSTMENTS

1. RV voltage adjustment (Signal unit)

Adjust the voltage to 16 V with VR-24.

2. RB voltage adjustment (Signal unit)

Adjust the voltage to 2.15 V with VR-25.

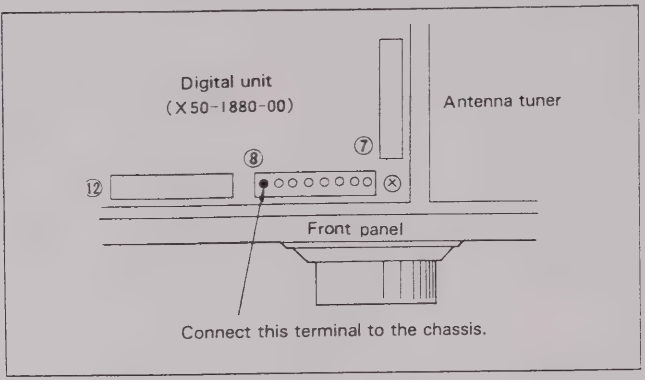
3. Supply voltage adjustment (Power Supply unit)

Adjust the voltage to 28.5 V with VR-1.

4. Digital display calibration

Connect the antenna, place the MODE switch to TUNE, and Zero-Beat to WWV at either 5, 10 or 15 MHz. Next, turn the 100 kHz calibrator ON and the marker signal will be superimposed on the WWV signal. If the calibrator is also at Zero-Beat, adjustment is not necessary.
If the calibrator is not Zero-Beat with WWV, adjust the Standard oscillator trimmer through the reference frequency adjustment access opening (on the side of the TS-930S) so the two signals are again Zero-Beat. Repeat this procedure 2 or 3 times. This completes calibration of the Digital Display. After calibration turn off the CAL switch.

other components are ICs. This unit functions to control frequency, display and the PLL unit.
Besides, the frequency display can be performed to 10 Hz by connecting terminal 8 on connector 8 of the digital unit to the chassis (that is, by grounding).



7.2-5 Final unit (X56-1430-00)

This unit includes the transmitter power amplifiers. The TS-930S outputs 100 W. Good IMD characteristics are provides by using a 28 V supply. In the TS-930S, the final stage is comprised of two MRF422 motorola transistors (collector dissipation 290 W) which are fan cooled.

7.2-6 Filter unit (X51-1280-00)

This removes unwanted spurious components such as harmonics from the transmission signal. This unit also detects VSWR to control ALC, and protection, and the SWR indicator circuit.

7.2-7 Power supply unit (X43-1430-00)

This unit supplies all the other units or their on-board regulators with regulated 28 V.

7.2-8 Switch unit (X41-1410-00)

The main front-panel switches and controls are mounted on this unit to simplify wiring.

7.3 AUTO-ANTENNA-TUNER (X57-1010-00)

This consists of a tuner section and a control section. The tuner section is π matching or T matching circuit which consists of coils and two variable capacitors, driven by motors. The control section detects the transmitter output to antenna match, and controls the drive motors to maintain best match.

SECTION 7. CIRCUIT DESCRIPTION

7.1 BLOCK DIAGRAM

The TS-930S block diagram is shown on page 39.

7.1-1 General

The TS-930S combines a quadruple conversion superheterodyne receiver with a triple conversion transmitter (double conversion in CW mode) using a filter-type SSB generator. Intermediate frequencies are 44.93 MHz, 8.83 MHz, 455 kHz, and 100 kHz. The 100 kHz IF is used only in receive. Local oscillators incorporated include a VCO (voltage controlled oscillator) controlled by the PLL, a HET (heterodyne) oscillator (36.1 MHz), CAR 1 oscillator (8.83 MHz), and CAR 2 oscillator (8.375 MHz). Both the transmitter and receiver use these local oscillators. The CAR 3 and CAR 4 oscillators permit CW pitch-change, and are used only by the receiver.

In the receiver mixer section, first and second mixers are balanced, using two junction FET's (2SK125) each. The third and fourth mixers use dual gate MOS FET's (3SK73). In the transmitter, all mixers (first, second and third) are balanced, using 3SK73, FET's.

The PLL, which consists of three minor loops, controls the VCO frequency (described above), to achieve dual digital VFO operation in 10 Hz steps. In addition, SSB slope tune and CW-VBT are achieved by combined control of the two receiver carrier oscillators.

Many accessory circuits are included. Adding to a monitor, VOX, RF speech processor and etc., which were incorporated in earlier models, new features such as a new Noise Blanker (NB2), automatic SWR meter, and Full Break-in capability are now incorporated.

7.1-2 Transmitter

From the microphone, audio signal comes to the Signal unit X57-1000-00 microphone amplifiers Q147, 146, 82, 83, 84, and to the balanced modulator D140 which converts this signal to a DSB (double sideband) 455 kHz signal. This signal passes a buffer amplifier Q87 and comes to a ceramic filter CF1 which converts this to an SSB (single sideband) signal. The first transmission mixer Q68, 69 then mixes the signal with CAR 2 (frequency 8.375 MHz), converting the signal frequency to 8.83 MHz. The resulting SSB signal passes a monolithic crystal filter (MCF XF1) and enters the second transmission mixer Q55, 56 which converts the signal frequency to 44.93 MHz by mixing with the HET signal (frequency 36.1 MHz). Then the third transmission mixer Q42, 43 mixes the signal with the VCO (frequency 45.08-74.93 MHz), converting the signal frequency to the final transmission frequency. This signal passes through a transmission band-pass filter (1.8-30 MHz) and, after being amplified by Q41, 40, 39, goes to the Final unit X56-1430-00. This unit amplifies signal power (Q1 ~ 5). Finally, the Low-pass filter unit X51-1280-00 removes spurious components from the signal. The resulting signal is supplied to the antenna, either directly, or through the optional Auto antenna tuner (X57-1010-00).

7.1-3 Receiver

Signal from the antenna goes to the Signal unit and passes one of nine band-pass filters. The RF unit X44-1490-00 amplifies (Q1) and mixes (Q2) the signal with the VCO frequency, converting the signal to the first IF frequency (44.93 MHz). The signal passes the post amplifier Q3, 4 and returns to the Signal unit where it passes a band-pass filter composed of two MCFs (XF1, 2). The signal then goes to the second reception mixer Q62, 63 which mixes the signal with the HET frequency, generating the second IF signal (8.83 MHz). The signal then passes the noise blanker gate (D82, 84 ~ 86) and MCF XF1 and goes to the third reception mixer Q65, 66 which generates the third IF signal (455 kHz) by mixing with CAR 2 (frequency 8.375 MHz). This third IF signal is amplified by Q67 and passes through ceramic filter CF1 and, after being amplified by Q128, enters the fourth receiver mixer Q129 which generates the fourth IF signal (100 kHz). This signal passes the notch filter (tuned by D217), a final IF amplifier Q130, and then it is demodulated (D238 ~ 241). In AM mode, the AM demodulator (D209, 219) operates. In all other modes, the ring demodulator works. The AF amplifiers Q160, 159 and IC3 drive the speaker.

7.2 UNITS

The TS-930S major units include the Signal unit, RF unit, PLL unit, Digital unit, Final unit, Low-pass filter unit, Power unit, and Switch unit.

7.2-1 Signal unit (X57-1000-11)

This unit includes most of the transmission/reception signal circuits, which control signal circuits, local oscillators, and accessory circuits.

Optional crystal filters are installed on this unit. They plug-in, and may be installed much easier than with conventional models.

7.2-2 RF unit (X44-1490-00)

The mixer section of the receiver centers in this unit. Using six junction FET's (2SK125), dynamic range is as high as 100 dB (using a 500 Hz [optional] filter).

7.2-3 PLL unit (X50-1880-00)

This includes three phase-locked loops to achieve digital VFO operation in 10 Hz steps. The reference signal oscillator is easily accessible from outside the case for adjustment.

7.2-4 Digital unit (X54-1670-00)

A 1-chip microprocessor is the heart of this unit. Most

■ PHONE PATCH OPERATION

Most phone patches will work satisfactorily without any modification to the radio. The PC-1 Phone Patch can be used with the TS-930S after some modification to the patch. The PC-1 mic input and output connectors are four pin. These, along with the output control cable, may be changed to eight pin connectors with a six conductor line (one shielded). Operation will be just as described on the PC-1 instruction sheet.

As an alternate, connect the PC-1 RX-IN terminals (top-hot, bottom-ground) to the transceiver line output jack and the patch output line originally at Pin 1 (HOT) and 4 (GROUND) to the transceiver line input jack, using RCA plugs. The PC-1 will operate at ON, but will not automatically disconnect the microphone and speaker from the transceiver.

Connectors required:
8 Pin chassis mount jack
  E06-0853-05
8 Pin cord mount plug
  E07-0852-05
1 Pin RCA plug
  E14-0101-05

Recommended settings are:

PC-1(A)	RX Gain	4
	TX Gain	4
	Null as necessary	
TS-930S	Vox Gain	1
	AF Gain	4
	Mic Gain	5
	Anti Vox Max	

■ FRONT FEET

The front panel can be elevated for operating convenience by extending the front feet.
Turn the front feet left and pull down.
Then turn right to lock.

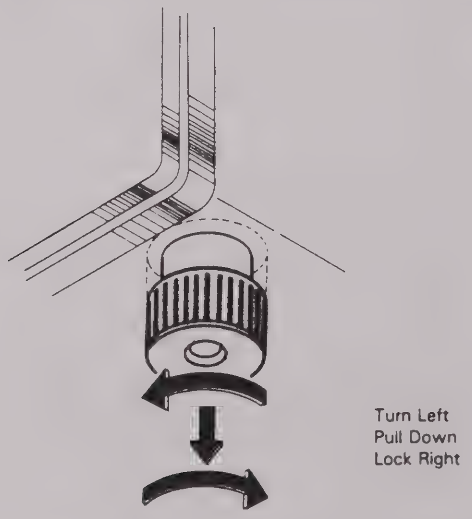


Fig. 6-5 Front feet extention

■ OPERATION WITH A SECOND RECEIVER

If you prefer operating another receiver in place of the TS-930S receiver section, you may share the antenna from the TS-930S during receive-time. Flip the rear panel RX-ANT switch (3) to EXTERNAL, and connect the antenna input of your second receiver to the RX ANT terminal (4) using 50 Ω coaxial cable. Reduce the AF Gain setting on the transceiver to zero. Mute the external receiver from Pin 4 and GROUND of the remote connector. If a linear amplifier is also used with the transceiver, diode isolate the external receiver and linear to Pin 4, and be sure combined current is less than the maximum rating for this terminal.

■ OPERATION WITH A SEPARATE RECEIVER ANTENNA

Use the XVRTR port and an 8 Pin DIN Plug, Part E07-0851-05

Pin 8	HF Ant output from the TS-930S
Pin 5	RX Ant input
Pin 3	GND

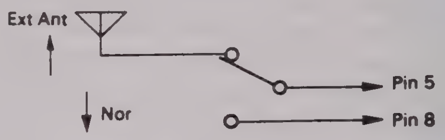
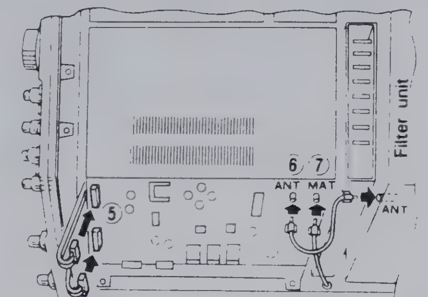


Fig. 6-6

Either wire your extra antenna to pin 5 and ground, and use the DIN plug as the connect/disconnect, or wire pins 8 and 5 and the external antenna through a SPDT switch, as shown.

■ OPERATION AS A SECOND RECEIVER

Use the REMOTE Connector. Connect Pin 3 (PTT line) (and Pin 2, GROUND) to your XMTR control output, to ground Pin 3 in TX. Feed the antenna through the primary transmitter or transceiver antenna relay.


6
7
ANT
MAT
ANT
5
Filter unit

⑤, ⑥, ⑦ Fig. 6-2C

6.5 REMOTE CONTROL WIRING

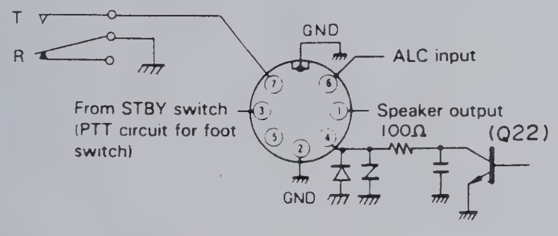
Fig. 6-3 shows the REMOTE connector. This 7 pin DIN plug can be used to control a linear amplifier or other external accessories.

Kenwood linear amplifier TL-922 can be connected to this unit with its remote cable. However, when a linear amplifier other than the TL-922(A) is used, change the connection as shown in Fig. 6-4.

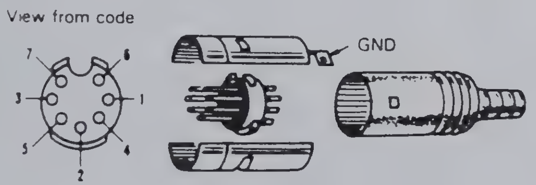
This allows remote operation with the relay connected to the terminal 7 of the DIN jack.

NOTE:

ALWAYS use shielded line for all connections.


T
R
GND
ALC input
From STBY switch
(PTT circuit for foot switch)
Speaker output
100Ω
(Q22)
GND
1
2
3
4
5
6
7

TS-930S Internal Wiring


View from code
GND
7
6
3
1
5
4
2

REMOTE connector

Fig. 6-3 REMOTE connector

PIN	FUNCTION	PIN	FUNCTION
1	Speaker output	5	No connection
2	Ground	6	ALC input ALC threshold level approx. −6 V
3	PTT line	7	Normally opened, closed in trasmit See Fig. 6-3.
4	Normally opened, closed in transmit		

Table 6-2

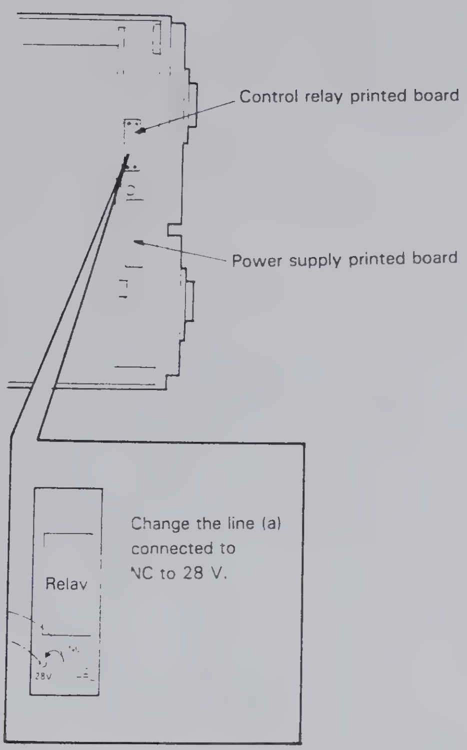

Control relay printed board
Power supply printed board
Change the line (a) connected to NC to 28 V.
Relay
28V

Fig. 6-4

■ OPERATION WITH A LINEAR AMPLIFIER

The TS-930S may be operated with any conventional linear amplifier which will accept up to approximately 125 watts RF drive, has a low current DC operated keying circuit, and returns approximately −8 ~ −10 V DC ALC (adjustable) back to the exciter. Please note that in order to operate QSK (full break-in), the linear amplifier must also be QSK capable.

For operation with a linear amplifier, refer to Fig. 6-3, TS-930S internal wiring.

Pin 6 ALC input

Pin 2 Ground

Pin 4 Control line center conductor

Use shielded line for both ALC and RL (control line).

Initial linear amplifier tune-up should be performed with the exciter in the tune mode, to reduce wear-and-tear on both the linear, and the exciter. Use of a dummy load is strongly suggested, since the bands are already sufficiently crowded.

■ SSTV OR AFSK OPERATION

The TS-930S will adapt to slow scan television AFSK or RTTY operation (besides the built-in FSK mode). For SSTV, the only cabling required are connections between the transceiver phone patch input and the camera output, and between the patch output and the monitor input.

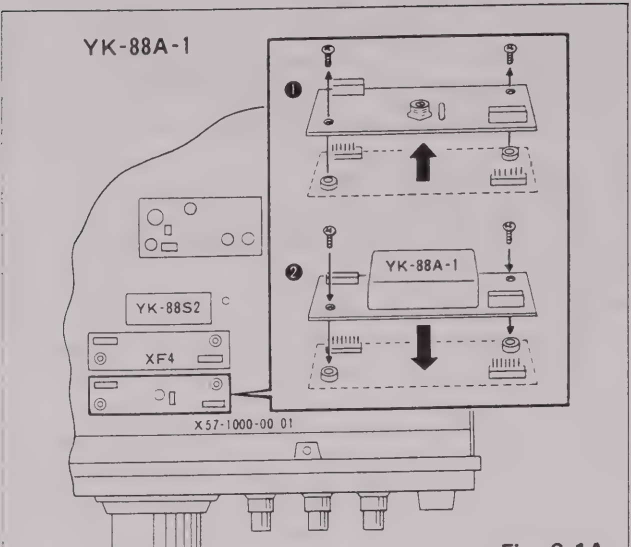

YK-88A-1
❶
❷
YK-88A-1
YK-88S2
XF4
X57-1000-00 01

Fig. 6-1A

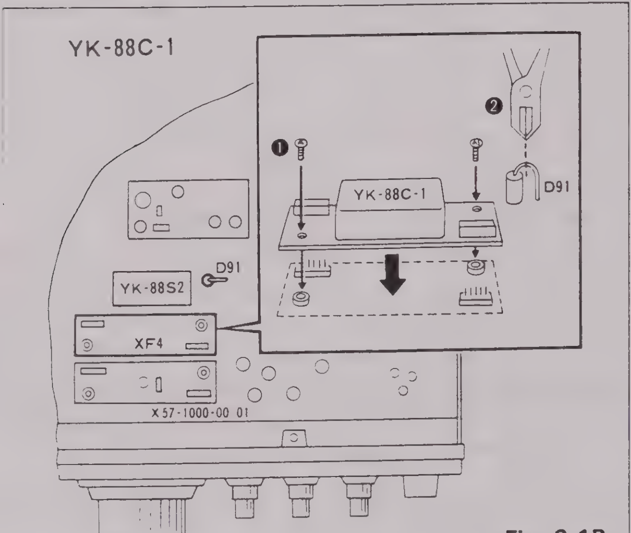

YK-88C-1
❷
❶
YK-88C-1
D91
YK-88S2
D91
XF4
X57-1000-00 01

Fig. 6-1B

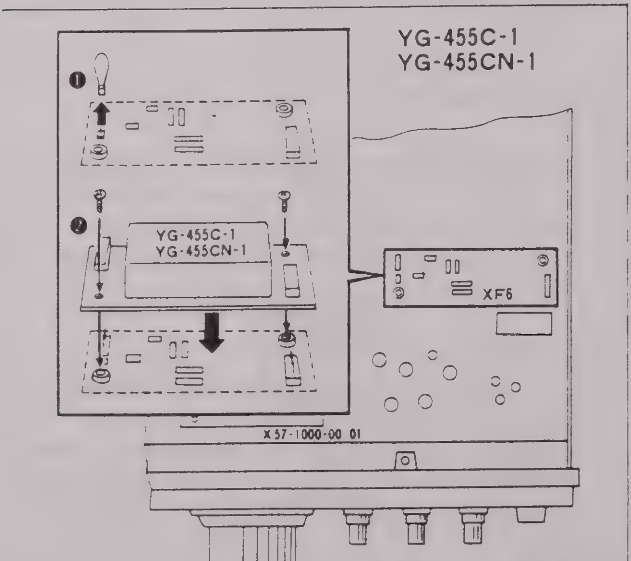

YG-455C-1
YG-455CN-1
❶
❷
YG-455C-1
YG-455CN-1
XF6
X57-1000-00 01

Fig. 6-1C

6.4 AT-930 INSTALLATION

(1) Remove the top and bottom covers (16 screws, total) from the transceiver.

(2) Remove the 4 screws and cable retainers located in the AT-930 mounting space.

(3) Using a long-nosed plier, carefully disconnect the coaxial cable from the filter unit ANT terminal

CAUTION:

Coax leads with connectors are not repairable. When connecting or disconnecting, do not break the male or female connectors.

(4) Secure the AT-930 to the transceiver using 4 screws.

CAUTION:

Do not pinch any leads between the AT-930 and transceiver chassis.

(5) Install the multi-connector to the AT-930.

(6) Connect the coaxial cable, which was removed from the filter unit, to the AT-930 MAT terminal.

(7) Connect the supplied coaxial cable between the AT-930 ANT terminal and the filter unit ANT terminal.

(8) Replace the transceiver top and bottom covers. The AT-930 is now ready for automatic operation.

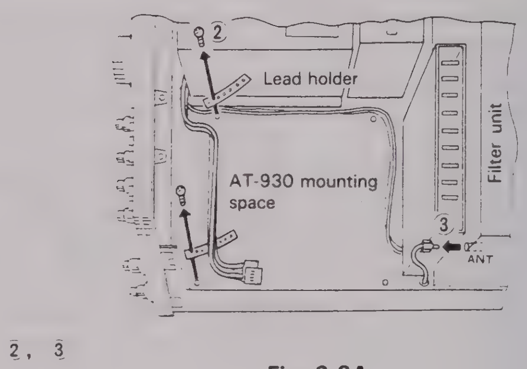

2
Lead holder
Filter unit
AT-930 mounting space
3
ANT
2, 3

Fig. 6-2A

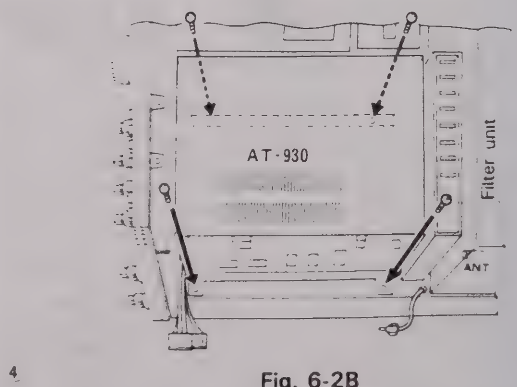

AT-930
Filter unit
ANT
4

Fig. 6-2B

6.2 INSTALLATION OF ACCESSORIES

1. **Preparation**
   - (1) Prepare the following tools
     - ○ No. 2 Philips screwdriver
     - ○ Diagonal cutters
   - (2) Unplug the power cord from the AC outlet before starting work.
   - (3) Remove the 8 top and 8 bottom case screws and remove the covers.

6.3 OPTIONAL FILTER INSTALLATION

Four optional crystal filters are available.

2. **Install up to three filters according to the following procedure**

(1) Remove the top and bottom covers (sixteen screws, total).

(2) Plug-in filters at their locations on the signal unit board. Tighten the supplied mounting screws.

■ YK-88A-1

(1) Remove the small circuit board fastened to the YK-88A-1 location.

(2) Plug-in the YK-88A-1 and replace the filter mounting screws.

■ YK-88C-1

(1) Plug-in the YK-88C-1 and replace the filter mounting screws.

(2) Cut one lead of diode D91 mounted on the signal unit board. Plug-in the filter and replace the filter mounting screws.

■ YG-455C-1 or YG-455CN-1

(1) Remove the jumpered connector at the filter position and plug-in the filter. Replace the filter mounting screws.

(2) Replace the top and bottom covers.

COMBINATION OF IF FILTERS

MODE switch	NAR-WIDE switch	883MHz IF	455kHz 1F	Overall pass-bandwidth	SSB SLOPE TUNE	CW VBT	AF TUNE *2	NOTCH	Note
SSB *4	WIDE or NARROW	2.7kHz (Built-in)	2.7kHz (Built-in)	2.7kHz	HI-CUT to 1500Hz LOW-CUT to 700Hz	–	–	Yes	
CW/FSK *2	WIDE	2.7kHz	2.7kHz	2.7kHz	–	600Hz ~ 2.7kHz	Yes	Yes	
	NARROW *1	(YK-88C-1 500Hz)	(YG-455C-1 500Hz)	500Hz	–	150Hz ~ 500Hz	Yes	Yes	Filter combination recommended for CW VBT
		2.7kHz	(YG-455CN-1 250Hz)	250HZ	–	*3	Yes	Yes	More narrower
AM	WIDE	– (YK-88A-1 6kHz)	6kHz 6kHz	6kHz 6kHz	– –	– 4 ~ 6kHz	–	Yes	
	NARROW	2.7kHz (YK-88A-1 6kHz)	2.7kHz 2.7kHz	2.7kHz 2.7kHz	– –	600Hz ~ 2.7kHz * *3	–	Yes	

Table 6-1

NOTES:

(　) = Optional filter installed.

*1 Shows recommended optional filter combination for CW.

*2 AF TUNE in FSK mode does not work.

*3 Although VBT circuit operates, not recommended.

*4 No optional SSB filters.

■ MC-60A BASE STATION MICROPHONE

Communications microphone with push-to-talk and remote frequency UP/DOWN switches.

■ HC-10: DIGITAL WORLD CLOCK

The HC-10 is a highly advanced world clock with dual display which can memorized 10 preset world major cities and 2 additional programmable regions.

■ PC-1A: PHONE PATCH

(Available only where phone patch operation is legal.)
Hybrid phone patch with VU meter for null and audio gain measurements.
The PC-1A Phone Patch provides interface between the transceiver and telephone line.
Providing excellent performance, it is designed with high isolation between receive input and transmit output.
Its compact design permits easy installation in a limited space.
(FCC Part 68 registered)

■ SO-1: THERMAL COMPENSATION CRYSTAL OSCILLATOR FOR THE TS-930S

It is a crystal oscillator used for the purpose of further improving the frequency stability of TS-930S. (Oscillation frequency: 20 MHz, Range of frequency correction: ±60 Hz)

For AM

■ **YK-88A-1** (−6 dB bandwidth : 6 kHz, 8,830.0 kHz)
Center Frequency : 8,830.0 kHz
Passband Width : 6 kHz (−6 dB)
Attenuation Bandwidth : 11 kHz (−60 dB)
Guaranteed Attenuation : More than 80 dB

For CW

■ ***YK-88C-1** (−6 dB bandwitdth : 6 kHz, 8,830.0 kHz)
Center Frequency : 8,830.0 kHz
Passband Width : 6 kHz (−6 dB)
Attenuation Bandwidth : 1.5 kHz (−60 dB)
Guaranteed Attenuation : More than 80 dB

■ ***YG-455C-1** (−6 dB bandwidth : 500 Hz, 455 kHz)
Center Frequency : 455.0 kHz
Passband Width : 500 Hz (−6 dB)
Attenuation Bandwidth : 820 kHz (−60 dB)
Guaranteed Attenuation : More than 80 dB

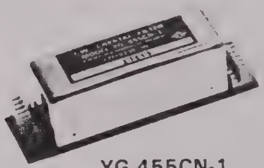
■ **YG-455CN-1** (−6 dB bandwidth : 250 Hz, 455 kHz)
Center Frequency : 455.0 kHz
Passband Width : 250 Hz (−6 dB)
Attenuation Bandwidth : 480 Hz (−60 dB)
Guaranteed Attenuation : More than 80 dB

* Recommended filter pair

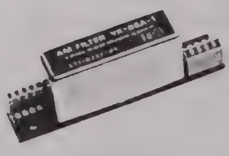
SO-1

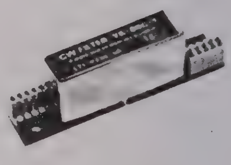
MC-60A

HC-10


YG-455CN-1

YG-455C-1


YK-88A-1


YK-88C-1

SECTION 6. OPTIONAL ACCESSORIES

6.1 PERIPHERAL DEVICES AND OPTIONS

The following optional accessories are available for more efficient and enjoyable operation of the TS-930S.

■ AT-930 AUTOMATIC ANTENNA TUNER

The TS-930S is available either with or without a built-in automatic antenna tuner. The tuning range is automatically pre-selected at band selection. Reflected power and final stage Ic (collector current) are monitored to control the tuning motors for the lowest SWR.

The tuner covers all amateur bands from 80 through 10 meters, including the new WARC bands. Matching capability is 20 to 150 ohms, unbalanced. The front panel "AUTO-THRU" switch allows bypassing the tuner, if desired.

■ SPEAKER SP-930

The SP-930 is a low-distortion speaker with selectable frequency response for high intelligibility in any mode. The frequency response is shaped by selectable built-in audio filters, which are effective in improving signal-to-noise ratio under certain interference conditions, or when receiving weak signals.

■ STATION MONITOR SM-220

Built around a basic 10 MHz oscilloscope, the SM-220 station monitor features, in combination with a built-in two-tone generator, a variety of waveform-observing capabilities.

It cannot be used as a Band Scope.

■ HF LINEAR AMPLIFIER TL-922/TL-922A

The TL-922/TL-922A is an HF linear amplifier operating at maximum legal power, and employing a pair of 3-500Z high performance transmitting tubes. The TL-922A (without 10 m band) is available only in U.S.A.

■ HS-5 COMMUNICATIONS HEADPHONES

Headphones designed for communications equipment. These light-weight open air-type headphones remain comfortable during extended operation. Easily attached earpads are provided.

■ HS-6 COMMUNICATIONS HEADPHONES

Deluxe, very lightweight headphones designed for communications equipment.

SP-930

TL-922/TL-922A

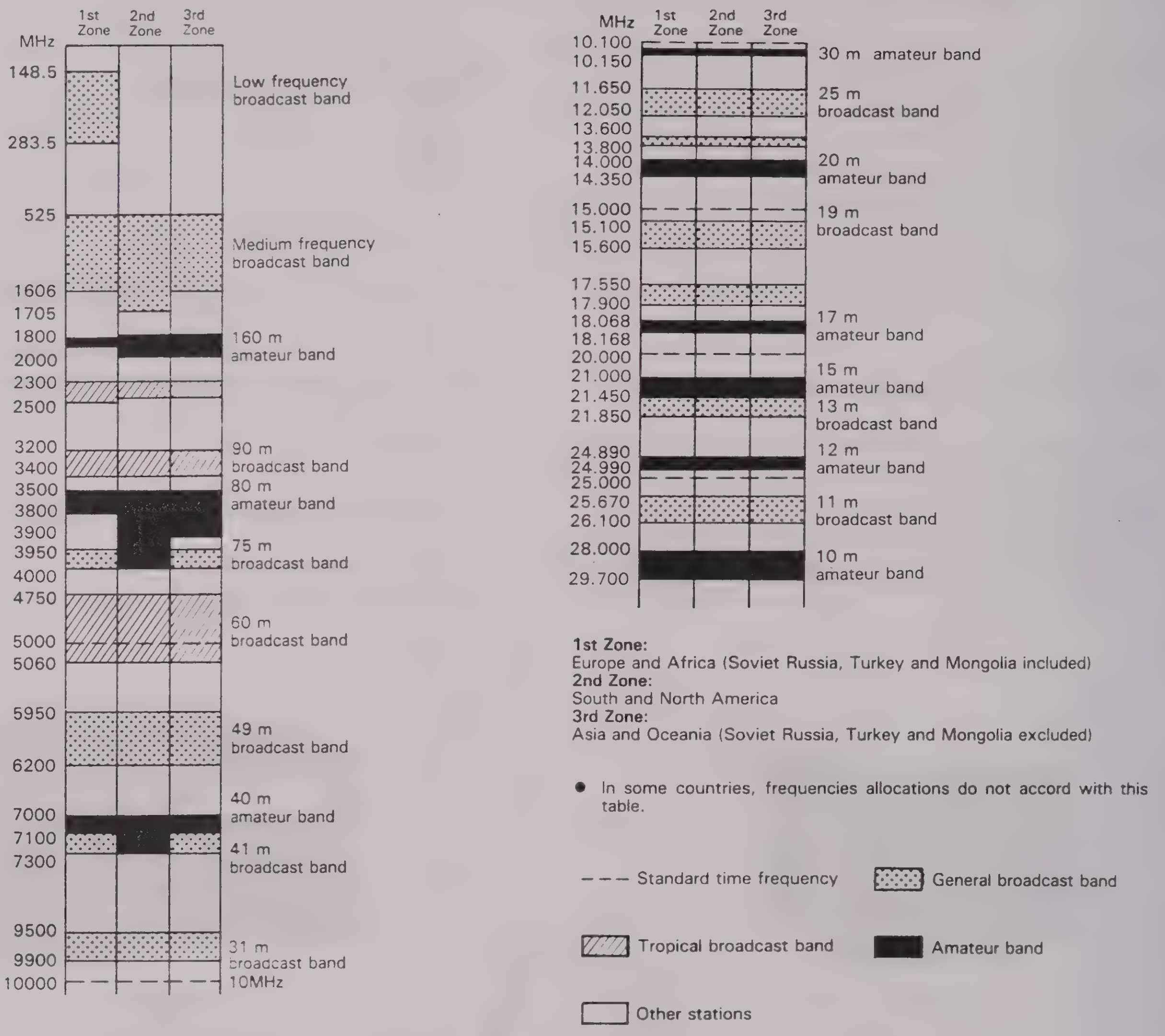
HS-6

SM-220

HS-5

5.10 SHORT WAVE RECEPTION

Radio Frequency Allocation



1st Zone:
Europe and Africa (Soviet Russia, Turkey and Mongolia included)
2nd Zone:
South and North America
3rd Zone:
Asia and Oceania (Soviet Russia, Turkey and Mongolia excluded)

- In some countries, frequencies allocations do not accord with this table.

Fig. 5-12

Frequency Distribution in the Broadcast and Amateur Bands.

The TS-930S receiver covers from 150 kHz to 30 MHz, to receive international broadcast and communication services.

As shown in the Frequency Allocation Chart, Fig. 5-12, broadcast and Amateur radio station frequencies are allocated in specific bands expressed in megahertz (MHz) or wavelenght in meters (m). Also in Fig. 5-12, the frequencies of "other station" are assigned for fixed station business use, marine mobile, aviation mobile, land mobile, radio beacon stations, etc.

NOTE:

1. Radio stations throughout the world are listed in the WORLD RADIO TV HANDBOOK or similar publications.
2. Antennas designed for HAM BANDS operation will generally provide satisfactory reception for SW stations near the HAM BANDS. For antenna construction details, see the ARRL ANTENNA HANDBOOK, or similar publications.

5.7 MEMORY CH (MEMORY CHANNEL) OPERATION

Use the MEMORY channels to record often used frequencies.

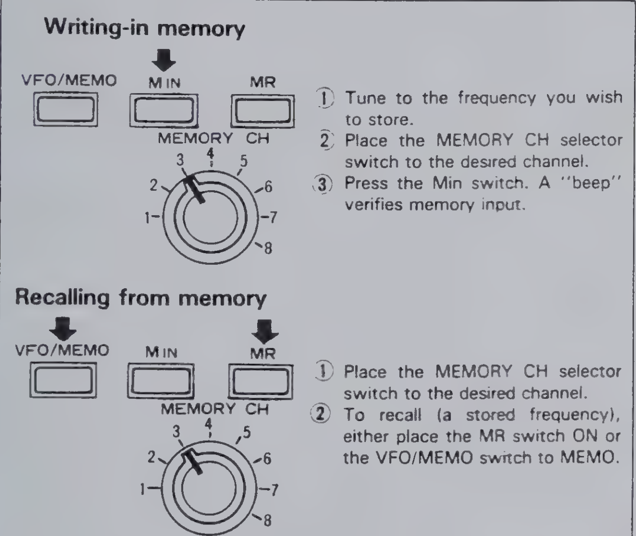
1. Writing-in memory

Depress the Min switch and the frequency selected by the main tuning control will be written in channel 1-8, as selected by the MEMORY CH switch (21)

2. Recalling from memory

There are two methods available to recall a frequency from memory:

- **Recall using the VFO/MEMO switch**
  Use this to operate on a MEMORY CH as a fixed (non-tuneable) frequency. Returning to VFO operation restores the original VFO frequency.



Writing-in memory

① Tune to the frequency you wish to store.
② Place the MEMORY CH selector switch to the desired channel.
③ Press the Min switch. A "beep" verifies memory input.

Recalling from memory

① Place the MEMORY CH selector switch to the desired channel.
② To recall (a stored frequency), either place the MR switch ON or the VFO/MEMO switch to MEMO.

Fig. 5-11

- **Recall using the MR switch**
  Use this to recall a memorized frequency (channel 1-8) to either VFO for tuneable operation. (The original VFO frequency will be lost.)

3. MEMORY channel battery backup

In the TS-930S, frequencies are stored in the microcomputer's RAM (random access memory). Data will be lost if the POWER switch (42) is turned off.
However, the memory may be retained by a battery backup system while the POWER switch is off. The RAM is powered by the batteries installed in the battery compartment (60). Backup current is less than 10 μA, and service life of the battery pack is approximately one year.

5.8 TF SET OPERATION

(1) Transmission frequency split may be either set or checked by simply depressing this switch.
If you depress this switch during A-R or B-R mode VFO operation, the transmission VFO operates and displays, while the transceiver remains in the reception mode.
If RIT is on, its frequency will be displayed and the transmit VFO will offset. Therefore, when setting transmission frequency, turn the RIT off.

(2) When this switch is released, the mode selected by the FUNCTION switch will be restored. This prevents accidental transmission on the receive frequency during a split-frequency QSO, while permitting quick selection of the transmit frequency.

(3) The TF-SET switch works only when the FUNCTION switch is at the A-R or B-R position (during split-frequency operation where the transmission frequency varies from the reception frequency). The TF-SET switch does not operate during transmission. All modes selected by the FUNCTION switch are indicated by the display group to prevent misoperation.

5.9 COOLING FAN OPERATION

The cooling fan operates automatically when the heat sink temperature rises, and stops when the temperature falls.
The heat sink is die-cast aluminum integral with the rear panel for sufficient heat dissipation. Therefore, the cooling fan will rarely operate during ordinary operation.
When the cooling fan operates, insure adequate ventilation to insure good heat dissipation.

■ KEY CONNECTION (Fig. 5-6)

Your key should be connected as illustrated in Fig. 5-6. Use shielded line from the key to transceiver.

NOTE:

When using an electronic keyer, set polarity of the keyer for positive keying.

■ CW break-in

During CW operation, the transceiver will automatically enter transmission mode when the key is depress, if the VOX switch is turned on in the standby mode.

There are two break-in modes in which TS-930S may operate.

(1) Semi break-in

Place the VOX switch ON and the Semi/Full switch at Semi. The SEND/REC switch remains in receive.

Transmission mode is automatically entered when the key is depressed and will remain on for an adjustable period after the key is released. Adjust the hold time with the VOX DELAY control.

(2) Full break-in

Set-up as for Semi break-in, except place the Semi/Full switch to Full.

The transceiver will immediately transfer to receive mode between keyed characters.

Full break-in capability allows the DX or contest operator to respond mode quickly to the calling station. To the RAG chewer, it allows a mode natural conversation.

CAUTION:

Full break-in operation is not possible in combination with the TL-922(A) linear amplifier.

10. Final protection

The TS-930S incorporates four final stage transistor protection circuits. Two protection circuits monitor antenna VSWR and final amplifier current and automatically reduce output power, if a fault occurs. A third circuit monitors the final heat sink temperature and controls the cooling fan when the temperature elevates to 50°C. This is sufficient to cool the heat sink under normal circumstances. The fourth protection circuit operates if the heat sink temperature has exceeded safe-limits because of poor convection cooling (above 75 ~ 80°C). Transmission will automatically be locked-out and the transceiver will return to reception mode.

When the temperature protection circuit is on the cooling fan operates at increases speed for faster cooling. When the heat sink temperature falls below to 65 ~ 70°C, this protection circuit resets and the transmitter is again enabled.

The fan will stop when the heat sink returns to 45°C.

5.5 BAND SWITCH

The BAND switch operates separately for VFO A and B. (See also 2 VFO operation.)

(1) BAND switch

These are momentary push switches operating an electronic latch. Data entry is confirmed by a "beep". Depress the pushbutton for any desired band.

(2) 1-MHz step switches

Depress the UP or DOWN switches and the frequency will increase or decrease in 1 MHz steps at each key press.

5.6 2 VFO OPERATION

The TS-930S has two VFOs, A and B, which are controlled by a microprocessor. The display group indicates which VFO is operating, and its full frequency.

FUNCTION switch	Reception	Transmission
A — R	A	B
A	A	A
B	B	B
B — R	B	A

Table 5-3

(1) FUNCTION switch

This selects VFO A, VFO B, VFO A-R, or VFO B-R. In the VFO A-R and VFO B-R modes, either split frequency (in the same band), or cross band operation is available. This system closely approximates the feel of operating a separate receiver and transmitter. The FUNCTION switch selects working VFOs, as summarized above.

In addition, the unused VFO may be used as a memory.

For exemple, when waiting for a scheduled contact, store the schedule frequency in one VFO and continue to operate or search on the other VFO until your scheduled contact.

(2) A = B switch

Use this switch to equalize the frequency of the idle VFO to that of the working VFO.

(3) D. LOCK switch

The D. LOCK switch permits electrically locking the frequency of the working VFO. With this switch on, VFO A and B frequencies will not vary when the tuning control or BAND switch is operated. For convenience, however, the RIT does operate.

quality, increase transmitter noise level, and in general make copying your signal more difficult.

Next, set the METER switch to ALC and adjust the PROCESSOR OUT control while speaking into the microphone. Ensure that meter deflection is within the ALC zone.

NOTE:

When a high-output microphone is used, input overload and distortion may result. To prevent this, use an attenuator in the microphone circuit as shown below, or connect a 10 – 33 kΩ resistor (depending on the microphone used) across the microphone input. (''Normal'' mic control setting should be approximately 12 o'clock).

The MC-60A microphone is recommended.

Microphone sensitivity: –56.0 dB ± 3 dB/50 kΩ; –71.0 dB ± 3 dB/500 Ω (preamp.-deactivated)

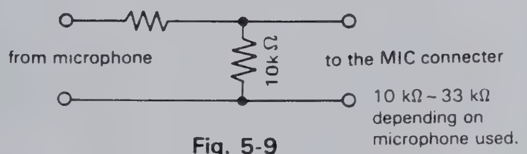


Fig. 5-9

7. Monitor

To monitor transmitted SSB signal quality, turn the MONITOR switch ON to demodulate a sample of the transmit IF signal.

This feature is useful for checking modulation, or when adjusting the speech processor.

When monitoring, use headphones to avoid audio feedback.

If the MIC gain control is incorrectly adjusted, the monitor output may sound distorted.

8. VOX (Voice Operated Transmit) OPERATION

Adjust the transceiver as described in the previous paragraphs. Depress the VOX switch to ON and while speaking into the microphone, increase the VOX GAIN control until the VOX relay just operates. For VOX operation it is sometimes desireable to close-talk the microphone to prevent background noises from tripping the transmitter.

(1) Check that the ALC reading for voice peaks is still within range on the meter. If necessary, readjust the MIC control for proper ALC reading.

(2) If the VOX circuit is activated by speaker output, adjust the ANTI-VOX control as necessary for proper VOX operation.

(3) Do not use excessive VOX or ANTI VOX gain more than necessary to control VOX operation. If the VOX circuit transfers between words, or holds too long, adjust the release time-constant by the DELAY control.

9. CW OPERATION (fig. 5-10)

Using shielded line, connect a key to the rear panel KEY jack, set the MODE switch to CW, and set the stand-by switch to SEND for transmitting.

In CW mode, side tone output is controlled by the MONI switch.

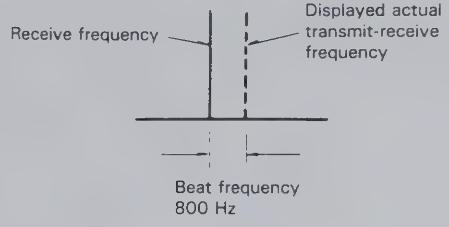


Fig. 5-10 CW Zero-Beat

(i) Reception

The TS-930S operates in two different CW modes; WIDE and NARROW. In the WIDE mode, the SSB filter (pass bandwidth 2.4 kHz, –6 dB) is used.

In the NARROW mode, option CW filters (YK-88C-1, YK-88C-CN-1 or YG-455C-1) may be used to narrow the IF pass bandwidth to 500 Hz (–6 dB) or 250 Hz.

During CW reception, the TS-930S operates in the LSB mode.

■ OPERATION WITHOUT CW FILTERS

To receive CW, set the CW Pitch control to its center position and the RIT switch to OFF. Adjust the main tuning for about an 800 Hz beat and your transmit frequency will be tuned (zeroed) to the transmit frequency of the station you are receiving. If zero beat cannot be tuned easily, place the MODE switch to TUNE and adjust the main tuning for zero beat. Then switch back to the CW mode. Your transmit frequency is now adjusted to that of the station you are working, and receive pitch will be approximately 800 Hz. You may now adjust the pitch control to suit your preference. If interference is encountered, adjust the CW VBT. For more convenient and effective CW operation, use of the optional CW filters is suggested.

■ OPERATION WITH CW FILTERS (OPTIONAL)

Set the VBT to normal and the pitch control to it's center position with the RIT OFF. Adjust the main tuning for maximum S-meter deflection. Receive signal pitch will be about 800 Hz, indicating correct tuning.

In CW mode, sidetone output is controlled by the MONITOR switch.

Note:
The frequency display indicates transmit carrier frequency.

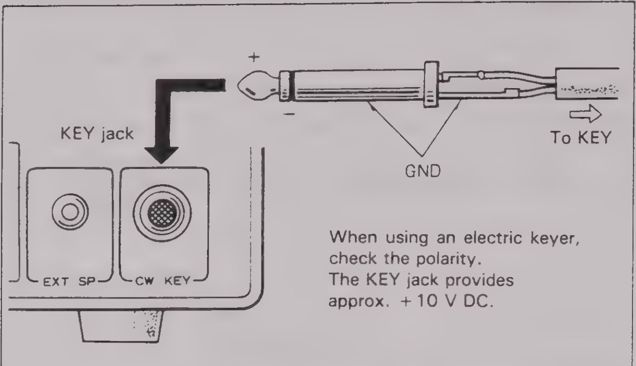

+
−
KEY jack
GND
To KEY
EXT SP
CW KEY
When using an electric keyer, check the polarity.
The KEY jack provides approx. +10 V DC.

Fig. 5-6 KEY jack connection

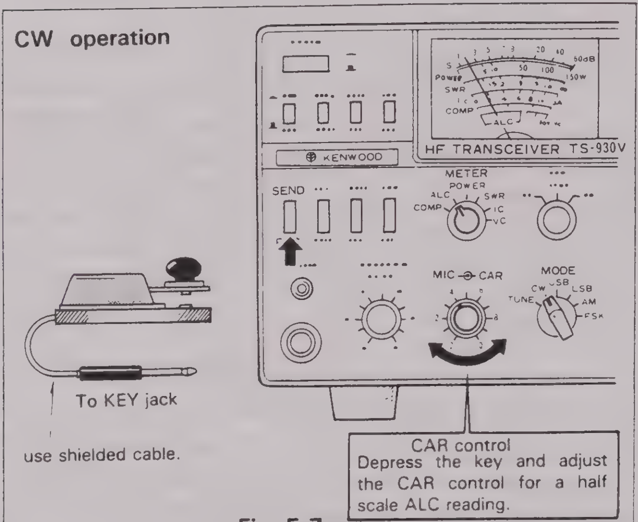

CW operation
HF TRANSCEIVER TS-930V
KENWOOD
SEND
METER
POWER
ALC
SWR
COMP
IC
VC
MIC
CAR
MODE
CW
SB
LSB
TUNE
AM
FSK
To KEY jack
use shielded cable.
CAR control
Depress the key and adjust the CAR control for a half scale ALC reading.

Fig. 5-7

3. RTTY

RTTY operation requires a demodulator and a teletypewriter. A demodulator including 2,125 and 2,295 Hz (170 Hz shift) filters will be acceptable and may be connected directly to the PHONE PATCH OUT jack. To use the transceiver's FSK circuit with older high voltage teletype equipment, use a keying relay in the teletypewriter closed loop and connect the relay contacts to the rear-panel RTTY KEY jack.

Figure 5-8 shows the frequencies relationship between reception and transmission with the TS-930S.

In FSK operation, the space frequency is indicated on the frequency display.

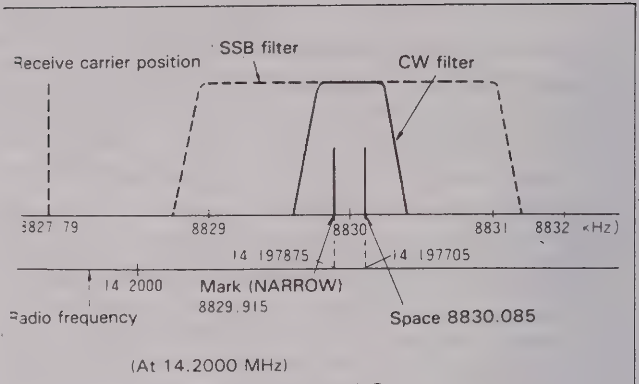

Receive carrier position
SSB filter
CW filter
8827.79
8829
8830
8831
8832 kHz)
14.197875
14.197705
14.2000
Mark (NARROW)
8829.915
Space 8830.085
Radio frequency
(At 14.2000 MHz)

Fig. 5-8

4. FSK transmission

1. Connect an FSK generator or RTTY terminal unit output to the rear-panel FSK KEY jack (9).
2. Place the MODE switch (51) to FSK.
3. Place the standby switch (45) to SEND.
4. Place the METER switch (2) to ALC.
5. Adjust the PROCESSOR-OUT control (41) for an on-scale ALC reading.
6. To receive connect the PHONE PATCH output to the demodulator input terminal.

- **Operation**

Place the MODE switch to FSK.

– CAUTION
When transmission is greater than 15 minutes continuous in the FSK mode, reduce the RF power to approximately 50 W by adjusting the SPEECH PROCESSOR control. In this condition, the ALC does not function. If the output power changes, re-adjust with PROCESSOR-OUT control.

5. AM transmission

Setting the MODE switch to AM allows AM transmission. To adjust carrier, adjust the CAR control so the power meter reading is approx. within 15 ~ 20 W.

Speak into the microphone and adjust the MIC volume control so the ALC meter deflects a little at the peak voice level. Note that the ALC full scale reading results in distortion.

6. SPEECH PROCESSOR

In SSB operation (particularly DX operation), it may be desirable to increase "talk-power" by using the speech processor. This may make the difference between a marginal, and a copiable signal.

- **Operation**

The speech processor system in the TS-930S is an RF clipper using two filters.

Turn the PROCESS switch ON and place the METER switch to COMP. Adjust the PROCESSOR IN control while speaking into the microphone in a NORMAL tone of voice for a peak COMP scale reading of no more than 10 dB. Do not overdrive the COMPRESSOR: This will deteriorate voice

5.3 Transmission (I)

This section covers adjustment of the transceiver for transmission.

1. Transmission output impedance

The TS-930S transmission output impedance is 50 ohms. Use only a 50 Ω antenna, and coaxial feed system.

2. SWR

Adjust antenna SWR to 1.5:1 or better. With the AT-930 Auto Antenna Tuner installed, it is possible to impedance match the antenna to the transceiver within the range of 20 Ω ~ 150 Ω (However, 30 ~ 100 ohms for 18 MHz and 24.5 MHz.). In all cases, it is recommended that antenna SWR is below 1.5:1.

3. Antenna terminal

Never operate the transmitter when the antenna terminal is open (neither antenna or dummy load connected).

To test the transceiver, use a 50 Ω, 100 W (minimum) dummy load. If you perform ON-THE-AIR test transmissions with an antenna, you may become the cause of interference with other stations on the band.

4. Initial setting

Refer to Table 5-2 for initial transmitter switch settings.

Table 5-2 Control and switch setting for transmission
(Set the Remaining controls as listed in Table 5-1.)

Switch	Position	Switch	Position
BAND switch	To desired band	RIT switch	OFF
Stand By switch	REC	AUTO switch	OFF
MODE switch	CW	PROC switch	OFF
METER switch	ALC	–	–

Table 5-2

5. Antenna-tuner

If the TS-930S is operated into an antenna with a high SWR, the final stage SWR protection circuit may operate (when SWR is greater than approximately 2:1). Therefore, use the AT-930 Auto Antenna Tuner or AT-230 (option) when antenna SWR is beyond nominal limits.

To operate the AT-930 Auto Antenna Tuner, place the MODE switch to TUNE, AUTO–THRU switch to AUTO and then transmit. Adjust the CAR control so the ALC meter deflects slightly. If, after changing bands, the auto antenna tuner does not stop at match within a reasonable time (within 20 seconds), momentarily return to the receive mode, and then again operate the tuner for a match. The tuner is capable of matching a 20 – 150 Ω load, or approximately up to a 2.5 : 1 VSWR. (However, 30 ~ 100 ohms for 18 MHz and 24.5 MHz.)

If the antenna and feed system exceed this range, the tuner may not stop, since it is beyond the auto tuner's capability. If the tuner does not stop within 20 seconds, discontinue auto-tuner operation and verify the VSWR of your system. Some adjustment to the antenna may be required to bring the radiating system within the tuner's capability.

Note:

When adjusting an external antenna tuner other than the AT-930, place the transceiver MODE switch to TUNE for reduce transmitter output.

5.4 Transmission (II)

To obtain maximum transmitter performance from your TS-930S you should understand the proper operation of the following controls and switches.

1. SSB transmission

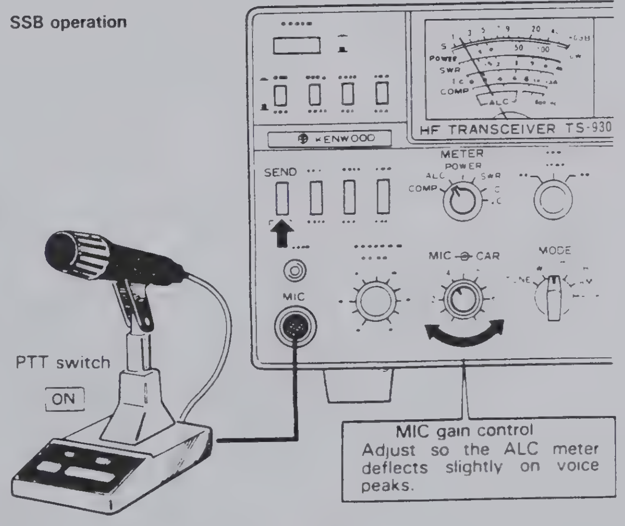
(1) Connect a microphone to the MIC input.

(2) For operation up to the 7 MHz band, place the mode switch to LSB. For operation on or above the 10 MHz band, use the USB mode.

(3) Place the METER switch to ALC, and the standby switch to SEND, or use the microphone PTT switch (if provided).

(4) Adjust the MIC gain control for an on-scale ALC reading on voice peaks. (Disregard power and IC meter readings in SSB- they are not accurate or relevant.)

SSB operation



PTT switch

ON

MIC gain control
Adjust so the ALC meter deflects slightly on voice peaks.

Fig. 5-5

2. CW transmission

(See page 24, CW operation, for details.)

(1) Using shielded line, connect a key to the rear-panel KEY jack.

(2) Place the MODE switch to CW, and the meter switch to ALC.

(3) Place the standby switch to SEND.

(4) Depress the key and adjust the CAR control for a half scale ALC reading (see Figure 5-7).

bandwidth), the passband-width varies from 500 Hz to approximately 150 Hz.

Since an optional filters center frequency is 700 Hz higher than that of the built-in 2.7 kHz filter, the CW receive tone will be about 800 Hz without using the pitch control. Fig. 5-3 shows the CW VBT function with an optional filter.

7 NOTCH CONTROL

If a single tone such as a CW signal is superimposed on the receive signal, turn the NOTCH ON and adjust the NOTCH control to eliminate or minimize the beat signal. A beat of approximately 1.5 kHz can be eliminated at the center position of the control. In USB, CW, or AM mode, a beat signal lower than 1.5 kHz can be eliminated by turning the control clockwise. In LSB or FSK mode, adjust the control counterclockwise.

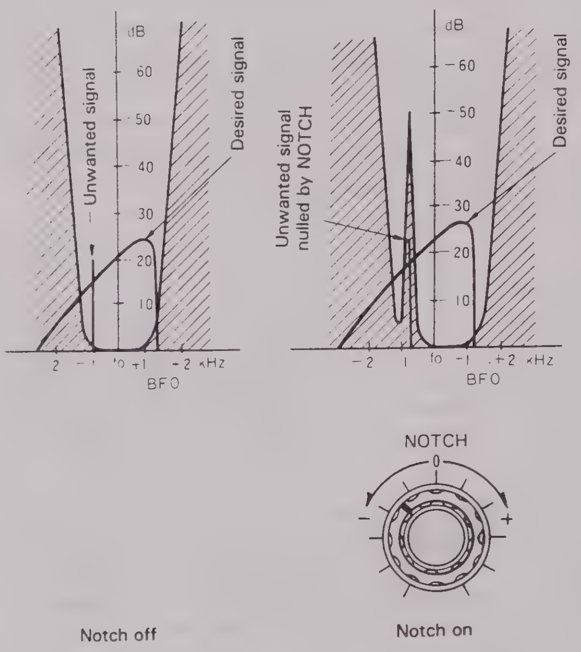


Fig. 5-4 NOTCH operation (LSB mode)

8 AF TUNE circuit

During CW operation, this audio filter having a peak center frequency of approximately 800 Hz, adjustable ±400 Hz, provides additional rejection of noise and interfering signals whose pitch (tone) falls outside the audio passband.

Turn the AF TUNE switch ON and adjust the AF TUNE control (33) to peak the desired signal.

9 NB (noise blanker) switch

- **NB1 switch:**

  For pulse type noise, such as generated by automotive ignition systems, turn the NB1 switch ON. Adjusting the NB LEVEL control varies the blanker's threshold, eliminating even low level noises.

NOTE:

If high level signal or noise is present on an adjacent frequency, do not use excessive NB threshold LEVEL as it may distort the received signal. If you are operating near other strong signals, use the RF ATT along with the noise blanker level control.

- **NB2 switch:**

  Turn on this switch if "woodpecker" radar pulse noise is the source of interference.

Simultaneous Use of the RF GAIN CONTROL and AGC Switch

If a strong signal (such as a local station) appears in the vicinity of the intended receive signal, the S meter may show unusual deflection due to the AGC voltage developed from the strong disturbing signal. If this occurs, turn the RF GAIN down so the meter pointer remains at about the original deflection peak and turn the AGC switch OFF. This will eliminate the unwanted AGC voltage and permit clear reception.

4 RIT

First, cancel any previously programmed offset using the Clear key (29), then turn the RIT switch ON.

The RIT control allows shifting the receive frequency ±9.9 kHz, displayed to the 100 Hz place, without changing the transmit frequency.

With the RIT switch ON, the RIT indicator will light, and receive frequency can be adjusted by using the RIT control.

NOTE:

When the RIT is ON, transmit frequency is different from the receive frequency. For normal operation, leave the RIT switch OFF. It should be turned ON only when needed.

To reset the RIT, depress the RIT-CLEAR switch.

5 SSB SLOPE TUNE control

During SSB reception, this permits shifting the apparent IF bandwidth to reject interference.

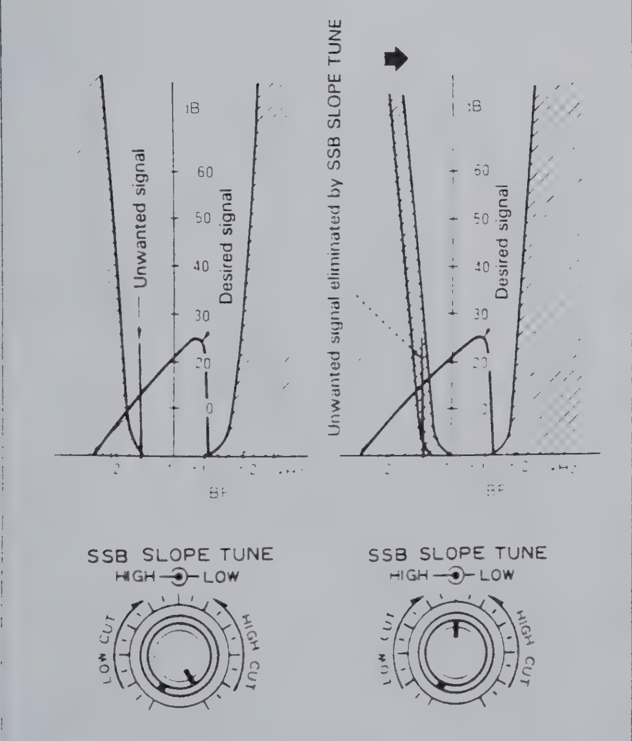

dB
60
50
40
30
20
10
Unwanted signal
Desired signal
BFO
Unwanted signal eliminated by SSB SLOPE TUNE
kHz
SSB SLOPE TUNE
HIGH
LOW
LOW CUT
HIGH CUT

Fig. 5-2 SSB SLOPE TUNE (HIGH CUT, LSB) control

- **SSB SLOPE TUNE HIGH CUT control:**
  Adjust the HIGH CUT control counterclockwise, and interference of higher frequency than the desired signal will be rejected. In the resulting AF signal, the high-frequency components are cut.
- **SSB SLOPE TUNE LOW CUT control:**
  Turn the LOW CUT control clockwise and interference of lower frequency than the desired signal will be rejected. In the resulting AF signal, the low-frequency components are cut. Maximum bandwidth occurs at low cut full counterclockwise, and high cut full clockwise.

6 CW VBT (Variable Bandwidth Tuning) control

This control is used to eliminate radio interference by changing the IF passband-width. Use this control in conjunction with the NOTCH filter to obtain optimum results.

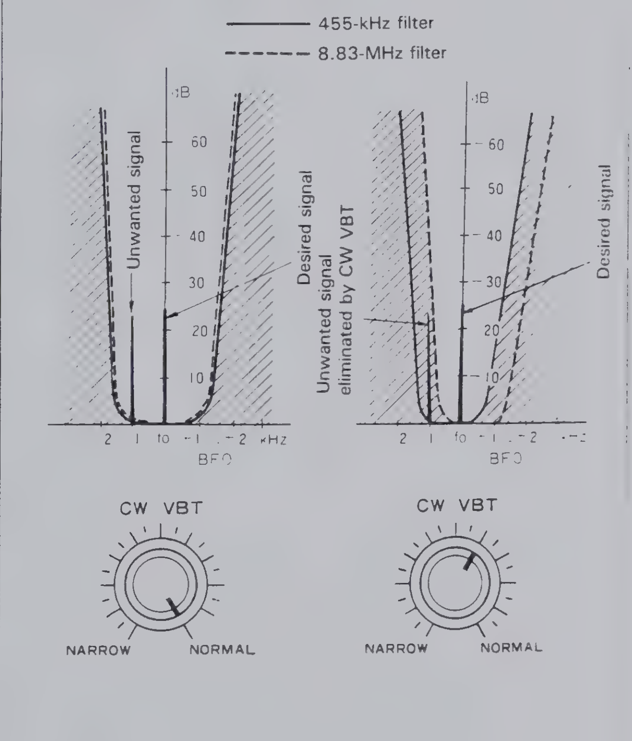

455-kHz filter
8.83-MHz filter
dB
60
50
40
30
20
10
Unwanted signal
Desired signal
Unwanted signal eliminated by CW VBT
Desired signal
2
1
fo
-1
-2
kHz
BFO
CW VBT
NARROW
NORMAL
CW VBT
NARROW
NORMAL

Fig. 5-3 CW VBT control

By setting the CW VBT control to the NORMAL position, maximum passband-width is obtained. The IF filter passband-width is narrowed as the control is adjusted counterclockwise, while center frequency remains unchanged. Fig. 5-3 illustrates operation. The range of variability depends on the type of optional filter used.

(i) When the filter bandwidth is 2.4 kHz (without an optional filter), the passband-width varies within the range of 2.4 kHz to 600 Hz.

(ii) With an optional YK-88C-1 filter (8.83 MHz, 500 Hz bandwidth) or YG-455C-1 filter (455 kHz, 500 Hz

SECTION 5. OPERATION

5.1 Reception (I)

The numbers in parenthesis refer to switch and control assignments as listed in the preceding chapter.

NOTE:

Set the MIC and CAR controls to minimum to prevent accidental transmission before tune-up. The TS-930S must be operated into a 50 ohm antenna or dummy load with an SWR less than 2:1. Random length wire antennas or light-bulb dummy loads should not be used. Conventional half-wave dipoles and beam antennas should be used only at or near their resonant frequency. Exceeding an SWR of 1.5:1 can damage the output stage of the transceiver.

(1) Basic Procedures for Receive Operation

The TS-930S has many advanced features such as CW, VBT, SSB slope tuning, NOTCH, etc. to assure enhanced receive operation. For the use of these specialized controls and switches, refer to Section 5.2 ''Reception (II)''.

With a suitable antenna and microphone or key connected to the transceiver, set the controls as described.

[INITIAL SETTING]

	Controls	Reception
Front panel	POWER switch	OFF
	VOX switch	OFF
	MONI switch	OFF
	STAND-BY switch	REC
	SSB reception	SLOW
	CW reception	FAST
	MODE	Selected reception mode
	MEMO switch	VFO
	FUNCTION	A
	RF ATT	0 dB
	RIT	OFF
	NOTCH	OFF
	AF TUNE	OFF
	D. LOCK	OFF
	AF control	Turn fully counterclockwise
	RF control	Turn fully clockwise
	SSB slope tune	High Turn fully clockwise Low Turn fully counterclockwise
Rear panel	RX ANT switch	OFF

Table 5-1

a. Turn the POWER switch (42) on. The meter and frequency display group will light , indicating the TS-930S is operating.

b. Select a band with the BAND switch (7) or 1 MHz step switches (8).

c. Advance the AF gain control (53) clockwise until some receiver noise or signal is heard from the speaker.

d. Adjust the main tuning within the frequency range of the selected Amateur band until a signal is heard. Tune the signal for clearest reception.

(2) WWV Reception

Set the band switch to ''10'' and turn the tuning control to 10.0 MHz.

5.2 RECEPTION (II)

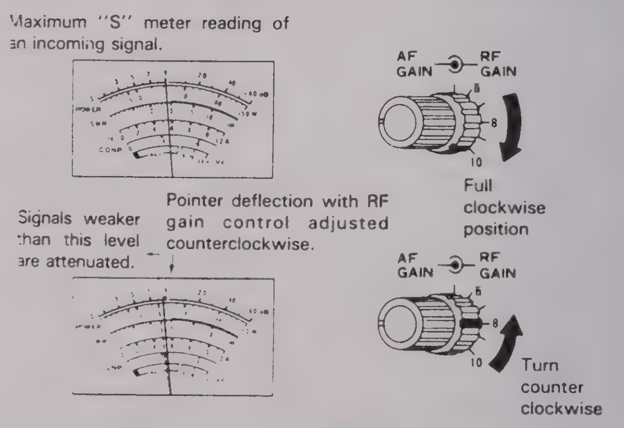
This section covers operation of controls and switches to provide maximum performance from the TS-930S.

1 RF ATT switch

A strong adjacent signal may conceal a desired weak signal, or the S meter may deflect off-scale when the receiver is tuned to a local strong signal. The input to the RF amplifier may be attenuated by 10, 20 or 30 dB using the RF ATT switch. This will reduce or eliminate interference and distortion from excessively strong signals.

2 RF GAIN CONTROL

RF GAIN is controlled by changing the AGC threshold voltage. Adjust the RF GAIN so the S-meter does not deflect excessively. This also reduces noise during reception. For normal operation, this control should be turned fully clockwise for maximum sensitivity.


Maximum ''S'' meter reading of an incoming signal.

Pointer deflection with RF gain control adjusted counterclockwise.

Signals weaker than this level are attenuated.

Fig. 5-1 RF GAIN Control Operation

3 AGC (AUTOMATIC GAIN CONTROL)

Set the AGC switch to the appropriate position: Generally for SSB and AM, SLOW, for CW and FSK FAST, and for very weak signals, the AGC may be turned OFF.

⑨ RTTY KEY jack (T)
Jack for FSK operation. Connect this directly to the low voltage (5 V DC or less) terminal unit output using an RCA plug. DO NOT connect a 60 MA local-loop direct: use a keying relay to provide a switched ground.

⑩ Power connector
Connector for AC power source. Make certain the transceiver's voltage selector is adjusted to your local line voltage BEFORE turn-on.

⑪ AC FUSE
This fuse protects the power supply against short circuits. Never use a higher amperage fuse than specified; it will eventually cause extensive damage. If the fuse blows, try to determine the cause before replacing. For 120 volt operation, use a 6 ampere fuse. For 220/240 volt, use a 4 ampere fuse.

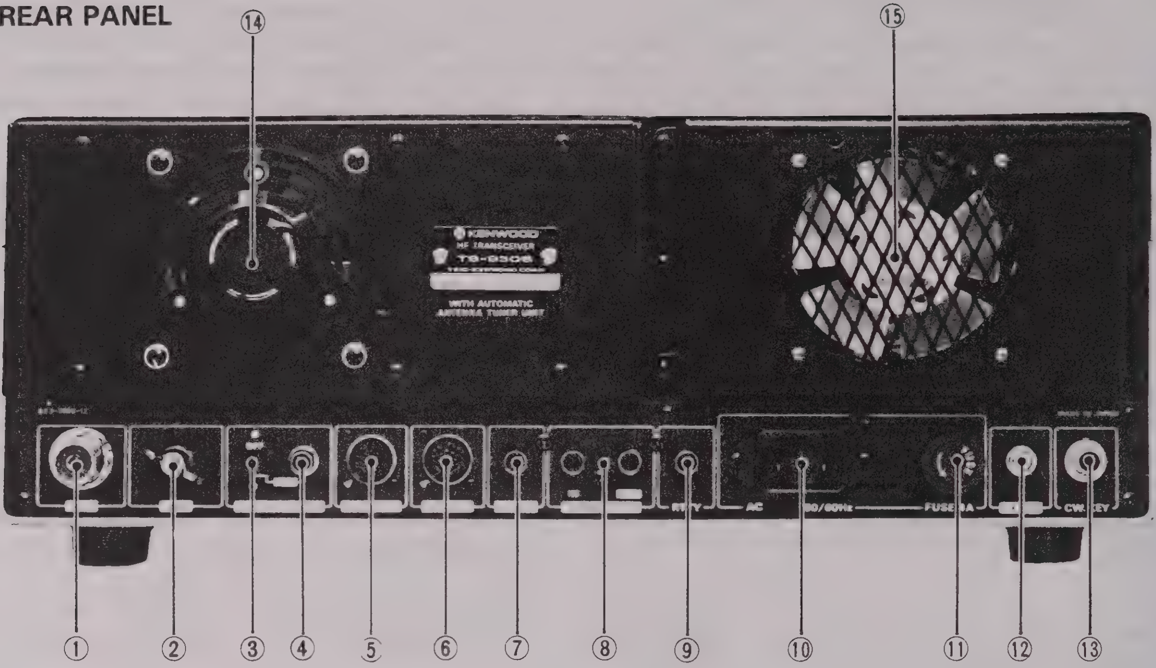
⑫ EXT. SP (speaker) jack (R)
The receiver audio output can be connected through this jack to an external 4 to 16 ohm speaker. The internal speaker is disconnected when an external speaker is connected.

⑬ CW. KEY jack (T)
Using shielded line, connect a key to this 1/4″ phone jack for CW operation. Key open-terminal voltage is approximately 10 V DC.

⑭ Cooling fan (final section)
Electronic-controlled automatic cooling fan for the final amplifier section.

⑮ Cooling fan (power supply)
Electronic-controlled automatic cooling fan for the power supply section.

4.2 REAR PANEL


⑭
⑮
KENWOOD
HF TRANSCEIVER
TS-930S
WITH AUTOMATIC ANTENNA TUNER UNIT
RTTY
AC
50/60Hz
FUSE 6A
CW KEY
①
②
③
④
⑤
⑥
⑦
⑧
⑨
⑩
⑪
⑫
⑬

① ANTENNA CONNECTOR

This SO-239 coax connector should be attached to a suitable 50 Ω antenna for transmitting and receiving.

② GND (ground) terminal

To prevent electric shock, as well as RFI and BCI, connect the transceiver to a good earth ground.

③ RX. ANT output switch

When using the RX. ANT terminal to feed another receiver, place this switch to the OUT position. The TS-930S's receiver antenna input will be disconnected.

④ RX. ANT terminal

Terminal to connect an external receiver. Signal from the antenna in use with the TS-930S will be output only during reception to the external receiver.

⑤ XVERTER (transverter) terminal

This 8 Pin DIN connector is used to interface a VHF or UHF transverter.

PIN	FUNCTION	PIN	FUNCTION
1	Ground	5	Transverter input (RX)
2	Relay control (+ on transmit)	6	Transverter ALC input
3	Ground	7	Transverter output (TX)
4	X-verter ON-OFF control	8	HF ANT output

Table 4-1 XVRTR Terminal Pin-OUTS

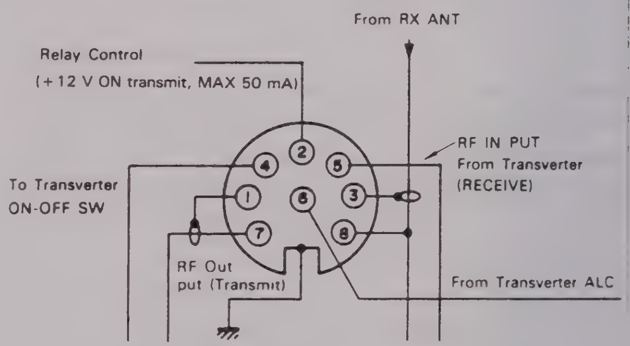

From RX ANT
Relay Control
(+12 V ON transmit, MAX 50 mA)
RF IN PUT
From Transverter
(RECEIVE)
To Transverter
ON-OFF SW
RF Out
put (Transmit)
From Transverter ALC
①
②
③
④
⑤
⑥
⑦
⑧

Fig. 4-1 TS-930S XVRTR Internal Wiring

⑥ REMOTE CONNECTOR

This connector is used to interconnect a linear amplifier or other accessory item. See page 32 for details. Use the 7 Pin DIN plug provided for connection.

⑦ IF OUT jack (R)

A high-level, narrow-bandwidth 100 kHz IF output, taken before the receiver produce detector, for scope display of the received signal waveform (to feed an SM-220, verticle input).

⑧ PHONE PATCH jacks

Use the IN terminal for transmitting a 600 Ω low impedance line or audio input (phone patch SSTV, AFSK, or other input). The OUT terminal provides 600 Ω line output for phone patch, SSTV, AFSK or other application.

KENWOOD

HF TRANSCEIVER

Model TS-930S

KENWOOD
HF TRANSCEIVER TS-930S
14.200.0

INSTRUCTION MANUAL

AFTER UNPACKING

It is advisable to save all original packing cartons (inner and outer) to protect your valuable transceiver from damage should you wish to transport it for remote operation or ship it for after-sales service.

The following explicit definitions apply in this manual. Be sure to read these definitions:

NOTE: If disregarded, inconvenience only — no damage or personal injury.

CAUTION: Equipment damage may occur, but not personal injury.

NOTE: This manual covers the TS-930S with the AT-930 Automatic antenna tuner installed. If your transceiver does not contain the AT-930, please disregard any mention of Automatic antenna tuner operation.

CAUTION:

Read Operating Manual Section 5 before placing transmitter in service.

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SECTION 1. SPECIFICATIONS

[GENERAL]

Transmitter Frequency Range:	160 m Band 1.8~2.0 MHz 80 m Band 3.5~4.0 MHz 40 m Band 7.0~7.3 MHz 30 m Band 10.1~10.15 MHz (10.0 MHz WWV) 20 m Band 14.0~14.35 MHz 17 m Band 18.068~18.168 MHz 15 m Band 21.0~21.45 MHz 12 m Band 24.89~24.99 MHz 10 m Band 28.0~29.7 MHz
Receiver Frequency Range:	150 kHz - 30 MHz
Mode:	A3J (USB, LSB), A1 (CW), F1 (FSK), A3 (AM)
Antenna Impedance:	50 ohms
With AT-930 antenna tuner	20 - 150 ohms (80 - 10 meter Amateur bands only. However, 30~100 ohms for 18 MHz and 24.5 MHz.)
Power Requirement:	120/220/240 VAC, 50/60 Hz
Power Dissipation:	Max. 510 W during transmission, 80 W during reception
Dimensions:	374(14-3/4″)W×141 (5-9/16″)H×350(13-13/16″)D mm (inches)
Weight:	With antenna tuner: Approx. 18.5 kg (40.8 lbs) Without antenna tuner: Approx. 16.8 kg (37.0 lbs)

[TRANSMITTER]

Final Power Input:	SSB/CW/FSK 250 W AM 80 W
Carrier Suppression:	Better than 40 dB
Unwanted Sideband Suppression:	Better than 50 dB (with 1 kHz modulation)
Harmonic Content:	Less than −40 dB
Audio Frequency Response:	400 - 2,600 Hz/−6 dB
Modulation:	SSB: Balanced modulation AM: Low level modulation (IF stage)
FSK Shift:	170 Hz
Modulation Distortion:	Less than −31 dB
FSK Shift:	170 Hz
Modulation Distortion:	Less than −31 dB
Microphone Impedance:	500 ohms~50 kohms
ALC Input:	−10 V DC MAX
Linear Amplifier Switching:	200 V DC MAX 100 mA

[RECEIVER]

Circuitry:	Quadruple conversion
Intermediate Frequencies:	1st IF: 44.93 MHz 2nd IF: 8.83 MHz 3rd IF: 455 kHz 4th IF: 100 kHz
Sensitivity (at 10 dB S+N/N)	
150 - 500 kHz:	Less than 1 μV for SSB, CW and FSK Less than 10 μV for AM
500 kHz - 1.8 MHz:	Less than 4 μV for SSB, CW and FSK Less than 32 μV for AM
1.8 - 30 MHz:	Less than 0.25 μV for SSB, CW and FSK Less than 2 μV for AM
Image Ratio:	More than 80 dB (1.8 MHz~30 MHz)
IF Rejection:	More than 70 dB (1.8 MHz~30 MHz)
Selectivity (W-wide, N-narrow filter selection)	
SSB, CW(W), FSK(W), AM(N):	2.7 kHz/−6 dB, 4.0 kHz/−60 dB
CW(N), FSK(N):	Without optional filter: same as CW(W), FSK(W) With optional YG-455C-1: 500 Hz/−6 dB, 820 Hz/−60 dB With optional YG-455CN-1: 250 Hz/−6 dB, 480 Hz/−60 dB With optional YK-88C-1: 500 Hz/−6 dB, 1.5 kHz/−60 dB
AM(W):	Without optional filter: 6 kHz/−6 dB, 18 kHz/−60 dB With optional YK-88A-1: 6 kHz/−6 dB, 11 kHz/−60 dB
SSB Slope Tune:	High-cut: More than 1500 Hz shift/−6 dB Low-cut: More than 700 Hz shift/−6 dB
CW VBT	
CW(W), FSK(W) AM(N):	600 Hz~2.7 kHz/−6 dB
CW(N), FSK(N):	Without optional filter: same as CW(W), FSK(W) With optional YK-88C-1 and YG-455C-1 installed: 150 Hz~500 Hz −6 dB
AM(W):	With optional YK-88A-1: 4 kHz~6 kHz/−6 dB

Frequency Stability:	Within ±200 Hz during the first hour after turn-on Within ±30 Hz any 30 minute period thereafter at constant temperature
Frequency Accuracy:	$\pm 1 \times 10^{-5}$ or better (at normal temperatures)
RIT Variable Range:	±9.99 kHz
Notch Filter Attenuation:	More than 40 dB
Phone Patch Output Z:	600 Ω
Audio Output Power:	More than 1.5 W across 8 Ω (at 10% distortion)

NOTE: The circuit and ratings may change without notice due to developments in technology.

AT-930 (Automatic Antenna Tuner)

Frequency Range:	Amateur bands from 80 ~ 10 m
Input Impedance:	50 Ω, unbalanced
Output Impedance:	20 ~ 150 Ω unbalanced
Insertion Loss:	Less than 1 dB at 3.5 MHz (at optimum match)
Through Power:	150 W max.
Motor Stop SWR Value:	Less than 1.2

SECTION 2. INTRODUCTION AND FEATURES

2.1 KENWOOD TS-930S

The TS-930S is a highly sophisticated all-solid state transceiver operating on all Amateur bands between 1.8 and 29.7 MHz, and a general coverage short wave receiver covering the 150 kHz to 30 MHz range. The TS-930S includes many built-in features usually found as extras on other transceivers. Included are VOX, 100 kHz calibrator, RIT, RF attenuator, two VFO's and two effective noise blankers. The TS-930S also includes automatic gain control (AGC), automatic level control (ALC), full- and semi-break-in CW with sidetone, an RF speech processor, speaker, built-in AC power supply and an optional built-in automatic antenna tuner.

Designed for operation on SSB, AM, FSK or CW, the TS-930S delivers more than 250 watts PEP input.

Any complicated electronic device may be damaged if operated incorrectly, and this transceiver is no exception. Please read all of the operating instructions before putting your TS-930S on the air.

2.2 FEATURES

- **160-10 Meters, with 150 kHz — 30 MHz General Coverage Receiver**

  Covers all Amateur frequencies from 160-10 meters, including the new WARC, 30, 17, and 12 meter bands, on SSB, CW, FSK, and AM. Features an excellent 150 kHz — 30 MHz general coverage receiver. Separate Amateur band access keys allow speedy band selection, and an UP/DOWN bandswitch changes in 1 MHz steps. A new, innovative, quadruple conversion, digital PLL synthesized circuit provides superior frequency accuracy and stability, plus greatly enhanced selectivity.

- **Excellent Receiver Dynamic Range**

  The use of dual 2SK125 J FET's in a unique parallel RF amplifier circuit, followed by two 2SK125's each, operated push-pull, in the 1st mixer, buffer amplifier, and 2nd mixer circuits results in outstanding two-signal characteristics and a substantially improved noise floor level. Typical two-tone dynamic range performance for the receiver section is 100 dB (20 meters, 500 Hz CW bandwidth at sensitivity of 0.25 μv, S/N 10 dB.), with an overall intercept point of +10 dBm, a noise floor level of −140 dBm, and a blocking dynamic range of 135 dB (20 meter, CW bandwidth).

- **Dual Mode Noise Blanker (''Pulse'' or ''Woodpecker'')**

  NB-1, with threshold control, for pulse-type noise. NB-2 for longer duration ''woodpecker'' type noise.

- **SSB IF Slope Tuning**

  Allows independent adjustment of the low and/or high frequency slopes of the IF passband, for best interference rejection.

- **CW VBT and Pitch Controls**

  The CW VBT (Variable Bandwidth Tuning) control tunes out interfering signals. The CW pitch control shifts the IF passband and simultaneously changes, both the received beat frequency and sidetone pitch. A ''Narrow/Wide'' filter selector switch is provided.

- **IF Notch Filter**

  100 kHz tuneable IF notch provides a deep, sharp, notch, to better than −40 dB. SSB slope tuning, CW VBT, or pitch controls do not affect the notch frequency.

- **Built-in Audio Filter**

  Tuneable, peak-type audio filter for CW. Peak center frequency is approximately 800 Hz, adjustable ±400 Hz.

- **All Solid State, 28 Volt Operated Final Amplifier**

  The final amplifier operates on 28 V DC for the lowest possible IM distortion (3rd order IMD −37 dB, typical). Power input is rated at 250 W PEP on SSB, 250 W DC on CW and FSK, and 80 W DC on AM. RF Power is supplied by two Motorola MRF-422 RF power transistors (Pc = 290 W/each) operating push-pull. Final amplifier protection circuits, cooling fan, and an SWR/Power meter are built-in.

- **Automatic Antenna Tuner, Built-In**

  Available with the AT-930 Antenna tuner either built-in, or as an option, which covers the 80-10 meter amateur bands, including the new WARC bands. The tuning range is automatically pre-set AT band selection to minimize tuning time. Impedance matching capability is 20 to 150 ohms, unbalanced. An ''AUTO-THRU'' switch is provided on the front panel.

- **CW Full Break-In**

  The CW Full Break-in circuit uses CMOS logic plus reed relays for maximum flexibility, coupled with smooth, quiet operation. Front panel switchable to semi-break-in.

- **RF Speech Processor**

  An RF clipper provides higher average ''talk-power'', plus improved intelligibility. Separate ''INPUT'' and ''OUTPUT'' front panel level controls.

- **Dual Digital VFO's**

  10 Hz step dual digital VFO's include the band. Mode selector for split frequency or cross-band operation. Each VFO continuously tunes the full receiver range. A

large, heavy, flywheel-type knob is used for ease of tuning. The T.F. Set switch allows fast transmit frequency setting for split-frequency operations. An A=B switch is provided for equalizing one VFO frequency to the other. A VFO "Lock" switch is provided. The RIT control allows ±9.9 kHz receive frequency shift.

- **Automatic VFO Step change**

  Tuning faster than 5.5~6.5 revolutions/second increases the tuning rate for easy QSY.

- **Eight Memory Channels**

  These store both frequency and band. VFO-MEMO switch allows use of each memory as either an independent VFO, (the original memory frequency can be recalled at will), or as a fixed frequency. Internal battery memory back-up, estimated 1 year life. (Three "AA" batteries not Kenwood supplied).

- **Fluorescent Tube Digital Display**

  Six digit fluorescent tube digital display has an analog type sub-scale with 20 kHz increment markers. A separate 2 digit display always indicates RIT frequency shift. The display also indicates VFO "A" or "B", Memory channel operation, RIT "ON" and VFO "LOCK".

- **AC Power Supply Built-In**

  120, 220, or 240 V AC, switch selected. (operates on AC only). Separate automatic fan provided to force-cool the power supply.

Other Features:

- SSB monitor circuit, 3 step RF attenuator, VOX, and 100 kHz marker
- 2.4 kHz SSB and 6 kHz AM filters built-in
- Display and meter dimmer switch

Optional Equipment:

• AT-930	Automatic antenna tuner
• SP-930	External speaker with selectable audio filters
• YG-455C-1	(500 Hz) or YG-455CN-1 (250 Hz) plug-in 455 kHz CW filters
• YK-88C-1	(500 Hz) CW and/or YK-88A-1 (6 kHz) AM plug-in 8.83 MHz filters
• MC-60A	Deluxe desk microphone with PTT, PTT lock, and UP/DOWN switches
• TL-922(A)	The linear amplifier TL-922A (without 10m band) is available only in U.S.A.
• SM-220	Station monitor for transmit, receive, and trapazoid displays
• PC-1A	Hybrid phone patch
• HC-10	Digital World Clock
• HS-6, HS-5, HS-4,	(Deluxe through standard) headphones

IMPORTANT

The MC-60A has a built-in amplifier. **When using the microphone connected to the TS-930S, be sure to set the MC-60A MIC AMP switch to OUT.**
With the MIC AMP switch set to IN, the microphone output level exceeds the rated input level of the TS-930S.

SECTION 3. INSTALLATION

3.1 UNPACKING

Remove the TS-930S from its shipping container and packing material and examine it for visible damage. If the equipment has been damaged in shipment, notify the transportation company immediately. Save the boxes and packing material for future shipping.

The following accessories should be included with the transceiver.

1. Instruction Manual (B50-3959-20) 1
2. Speaker Plug 1/8″ (E12-0001-05) 1
3. 7 Pin DIN Plug (E07-0751-05) 1
4. Fuse (6A) (F05-6021-05) or
   (4A) (F05-4022-05) 1
5. Power cable 1

3.2 OPERATING PRECAUTIONS: READ BEFORE OPERATING

It is suggested you read this instruction manual carefully before attempting operation with your new TS-930S, and that you follow the suggested operating procedures.
Especially note that the final amplifier power transistors might be damaged during transmission if the transceiver is operated into an improper load.
Observe the following transmitter precautions:

1. If the built-in antenna tuner is used, operate only after automatic tuning is completed, tuning must be performed with the MODE switch at the TUNE position.
2. Use only a resonant, 50 Ω antenna which is adjusted for an SWR of 1.5 or less.
3. DO NOT transmit without an Antenna or Dummy Load.

3.3 OPERATING LOCATION

As with any solid state electronic equipment, the TS-930S should be kept from extremes of heat and humidity.
Choose an operating location that is dry and cool, and avoid operating the transceiver in direct sunlight. Also, allow at least 3 inches clearance between the back of the equipment to any object. This space allows an adequate air flow from the ventilating fans to keep the transceiver cool.

CAUTION:
Do not operate the radio in an RF Field greater than 6 V RF. Receiver damage may occur.

3.4 CABLING (See Figure 3-2.)

■ GROUND

To prevent electric shock, and reduce the possibility of TVI and BCI, connect the transceiver to a good earth ground, through as short and heavy a lead as possible. Use ground rods or metal cold water feedline.

NOTE:
A ground connection greater than 1/4 λ away from the transceiver may be a good DC ground, but NOT an RF Ground.

■ ANTENNA

Connect through a 50 ohm antenna feedline to the coaxial connector on the rear panel.

■ KEY

If CW operation is desired, connect a key to the KEY jack. Use shielded line or coaxial cable.

■ POWER CONNECTIONS

Make sure the POWER switch on the front panel is turned off, the stand-by switch is in the REC position, the VOX is off, and the line voltage is correct. Then connect the power cord to the line source.

■ AC POWER

For fixed station operation, the TS-930S is supplied to operate from a 120 V AC, 220 VAC or 240 VAC 50/60 Hz power source capable of supplying 510 watts or more.

For units shipped to the U.S.A., the switch is set at 120 with a 6-ampere fuse installed.
For units shipped to the European, Central and South American, and African countries, the switch is set at 220 with a 4-ampere fuse installed.
For units shipped to the Oceanian countries, the switch is set at 240 with a 4-ampere fuse installed.

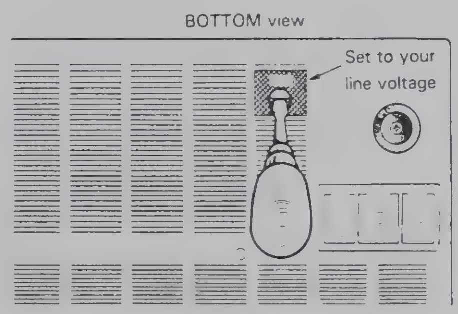


Fig. 3-1A Voltage selector switch

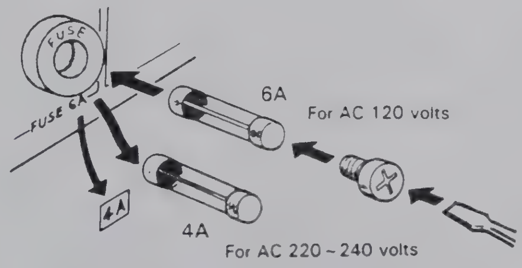


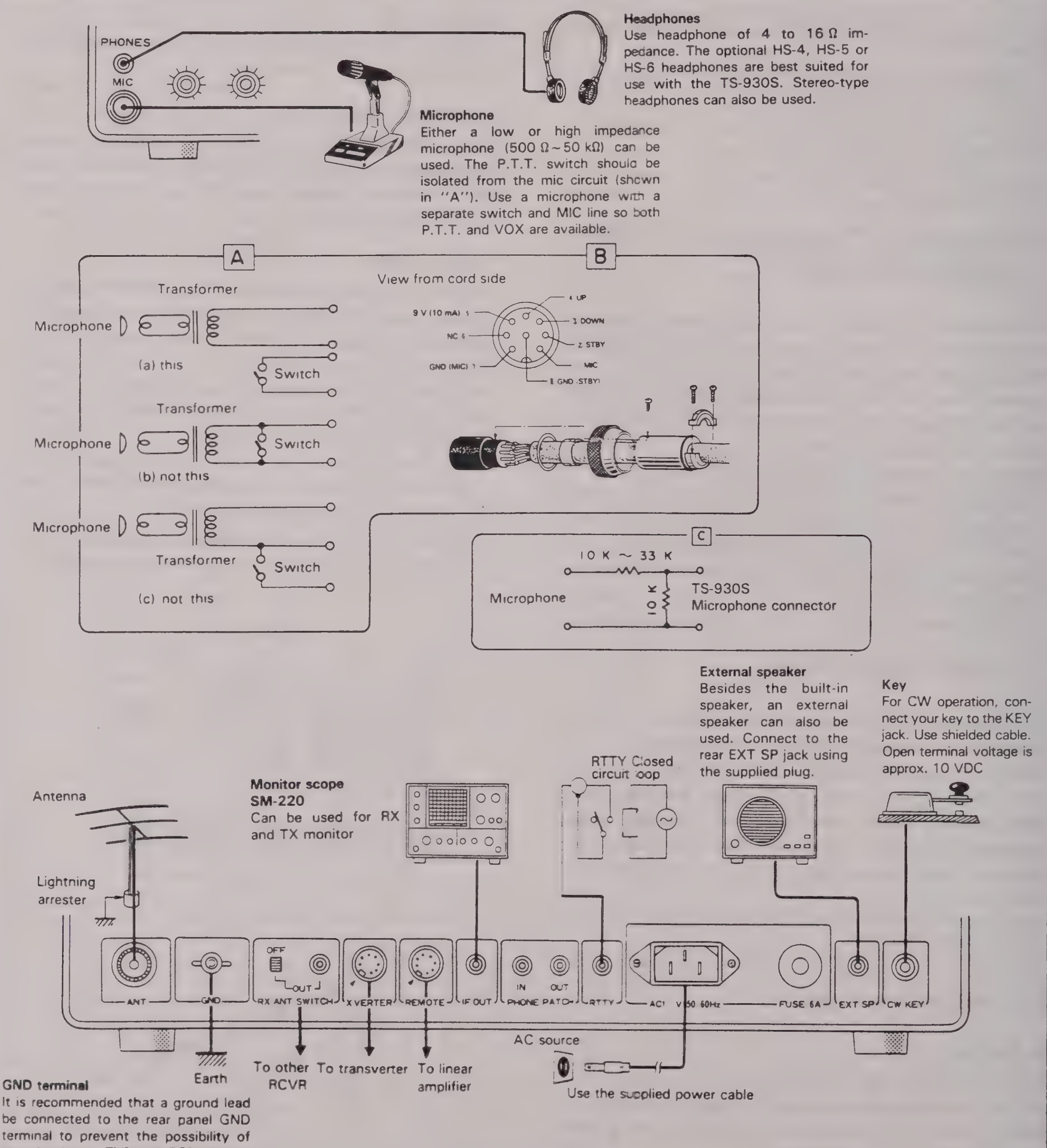
Fig. 3-1B Fuse replacement

3.5 MICROPHONE

Attach the microphone connector to a suitable microphone, as shown in Figure 3-2. Be sure the microphone PTT switch is separate from the microphone circuit, as shown in Figure 3-2A.

Note that a microphone using a common ground terminal should not be used, to prevent ground loops and unwanted switching noise.

The microphone input is designed for 500 Ω ~ 50 kΩ microphones. Normally, use it at 500Ω. The choice of microphone is important for good speech quality, and



PHONES
MIC
A
Transformer
Microphone
(a) this
Switch
Transformer
Microphone
Switch
(b) not this
Microphone
Transformer
Switch
(c) not this
B
View from cord side
4 UP
9 V (10 mA) 5
3 DOWN
NC 6
2 STBY
GND (MIC) 7
MIC
8 GND (STBY)
C
10 K ~ 33 K
Microphone
10 K
TS-930S
Microphone connector
Antenna
Lightning arrester
RTTY Closed circuit loop
ANT
GND
OFF
OUT
RX ANT SWITCH
X VERTER
REMOTE
IF OUT
IN
OUT
PHONE PATCH
RTTY
AC1 V 50 60Hz
FUSE 6A
EXT SP
CW KEY
Earth
To other RCVR
To transverter
To linear amplifier
AC source
Use the supplied power cable

Headphones
Use headphone of 4 to 16 Ω impedance. The optional HS-4, HS-5 or HS-6 headphones are best suited for use with the TS-930S. Stereo-type headphones can also be used.

Microphone
Either a low or high impedance microphone (500 Ω ~ 50 kΩ) can be used. The P.T.T. switch should be isolated from the mic circuit (shown in "A"). Use a microphone with a separate switch and MIC line so both P.T.T. and VOX are available.

Monitor scope SM-220
Can be used for RX and TX monitor

External speaker
Besides the built-in speaker, an external speaker can also be used. Connect to the rear EXT SP jack using the supplied plug.

Key
For CW operation, connect your key to the KEY jack. Use shielded cable. Open terminal voltage is approx. 10 VDC

GND terminal
It is recommended that a ground lead be connected to the rear panel GND terminal to prevent the possibility of electric shock, TVI and BCI. Use as short and heavy a lead as possible.

Fig. 3-2 CONNECTION

should be given serious consideration. The crystal lattice filter in the transceiver provides all the restriction necessary on audio response, and further restriction in the microphone is not required. It is more important to have a microphone with a smooth, flat response throughout the speech range.

Follow the microphone manufacturer's instructions for connecting the microphone cable to the plug. With many microphones, the push-to-talk button must be pressed to make microphone audio available. For VOX operation, this unwanted feature may be eliminated, if desired, by opening the microphone case and permanently bridging the contacts which control the microphone audio.

Standard microphone sensitivity is within the range of −50 dB to −60 dB. If a microphone having a higher sensitivity is used, the ALC and compressor circuits may not function properly. In this case, insert in the mike line an attenuator as shown in Fig. 3-2C. A typical MIC gain control setting is 12 o'clock. If you must run this control at 9 o'clock or less, use an attenuator.

3.6 KEY

If CW operation is desired, connect a key to the KEY jack. Use shielded cable, and a standard (mono or 2P) phone plug.

3.7 EXTERNAL SPEAKER AND HEADPHONES

Receive audio output from the TS-930S is 1.5 watts at 4 to 16 ohms. The TS-930S has a built-in the speaker, plus an external speaker jack on the rear panel. The speaker may be an 8-ohm permanent-magnet type, 4 inches or larger. The internal speaker is disconnected when an external speaker is used. Headphones should also be 4 to 16 ohms impedance. When the headphones are connected to the front-panel PHONES jack, the speaker is disabled.

3.8 GROUND

To prevent electric shock, and reduce the possibility of TVI and BCI, connect the transceiver to a good earth ground through as short and heavy a lead as possible.

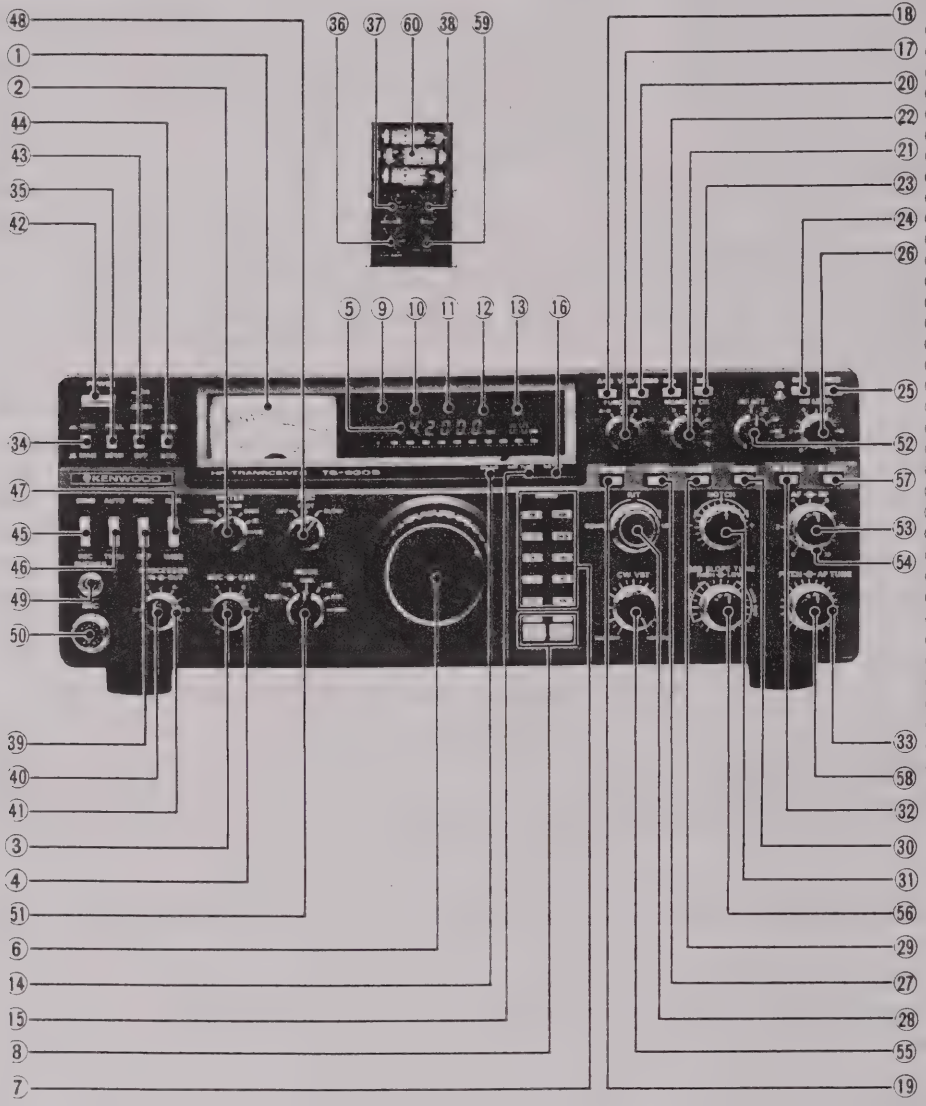
3.9 ANTENNA

Any of the common antenna systems designed for use on the high frequency amateur bands may be used with the TS-930S, provided the input impedance of the transmission line is not outside the capability of the AT-930 Automatic Antenna Tuner pi-output matching network. The transmission line should be coaxial cable. An antenna system which shows a standing wave ratio of less than 1.5:1 when using 50 ohm coaxial transmission line, or a system that results in a transmission line input impedance that is essentially resistive, and between 20 and 150 ohms will take power from the transceiver through the AT-930. If open wire or balanced type transmission line is used with the antenna, a suitable antenna tuner with balun is recommended between the transceiver and the feed line. Methods of construction and operating such tuners are described in detail in the ARRL Antenna Handbook, or similar publications. For operation on the 160, 75 and 40 meter bands, a simple dipole antenna, cut to resonance in the most used portion of the band, will perform satisfactorily. For operation on the 10, 15 and 20 meter bands, the efficiency of the station will be greatly increased if a good directional rotary antenna is used. Remember that even the most sophisticated transceiver is useless without a good antenna.

CAUTION:

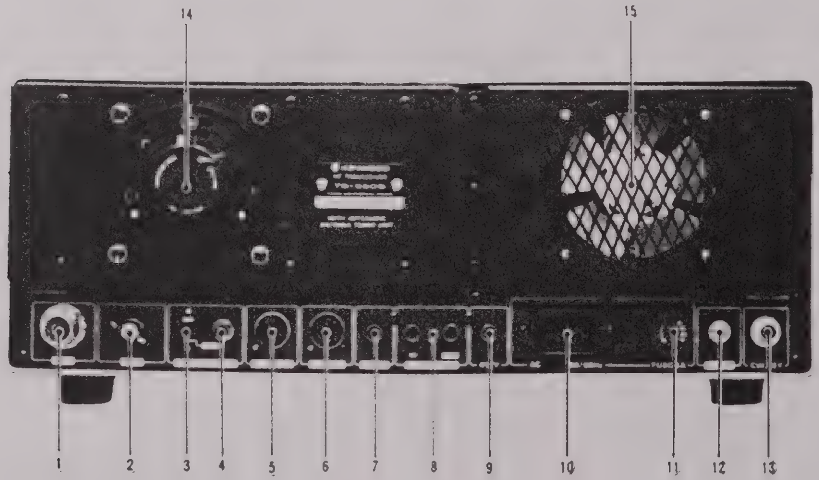
Protect your Equipment — Use a LIGHTING ARRESTOR.

SECTION 4. CONTROLS AND THEIR FUNCTIONS



FRONT PANEL

① Meter
② METER switch (T)
③ MIC (microphone gain) control (T)
④ CAR (carrier level) control (T)
⑤ Frequency display
⑥ Tuning knob
⑦ BAND switch
⑧ 1 MHz step switch
⑨ D. LOCK switch
⑩ VFO A indicator
⑪ VFO B indicator
⑫ MEMO (memory) indicator
⑬ RIT indicator (R)
⑭ ON AIR indicator (T)
⑮ ANT TUNE (antenna-tuner) indicator (T)
⑯ NOTCH indicator (R)
⑰ FUNCTION switch
⑱ A = B switch
⑲ TF-SET switch
⑳ VFO/MEMO (memory) selector
㉑ MEMORY CH selector
㉒ MIN (memory write) switch
㉓ MR (memory recall) switch
㉔ NB 1 (noise blanker 1) switch (R)
㉕ NB LEVEL control (R)
㉖ NB 2 (noise blanker 2) switch (R)
㉗ RIT switch (R)
㉘ RIT control (R)
㉙ RIT-CLEAR switch (R)
㉚ NOTCH switch (R)
㉛ NOTCH control (R)
㉜ AF TUNE switch (R)
㉝ AF TUNE control (R)
㉞ VOX switch (T)
㉟ CW break-in selector (T)
㊱ VOX GAIN control (T)
㊲ ANTI VOX control (T)
㊳ DELAY control (T)
㊴ PROC (processor) switch (T)
㊵ PROCESSOR-IN (input level) control (T)
㊶ PROCESSOR-OUT (output level) control (T)
㊷ POWER switch
㊸ MONI (monitor) switch (T)
㊹ DIM (dimmer) switch
㊺ Standby switch
㊻ Auto Antenna Tuner switch (T)
㊼ NAR/WIDE filter bandwidth selector (R)
㊽ AGC switch (R)
㊾ PHONES (headphones) jack (R)
㊿ MIC (microphone) connector (8 Pin) (T)
(51) MODE switch
(52) RF ATT (RF attenuator) switch (R)
(53) AF (AF gain) control (R)
(54) RF (RF gain) control (R)
(55) CW VBT control (R)
(56) SSB SLOPE TUNE control (R)
(57) DIAL LOCK switch
(58) PITCH control (R)
(59) CAL (marker) switch (R)
(60) Battery (memory backup) compartment

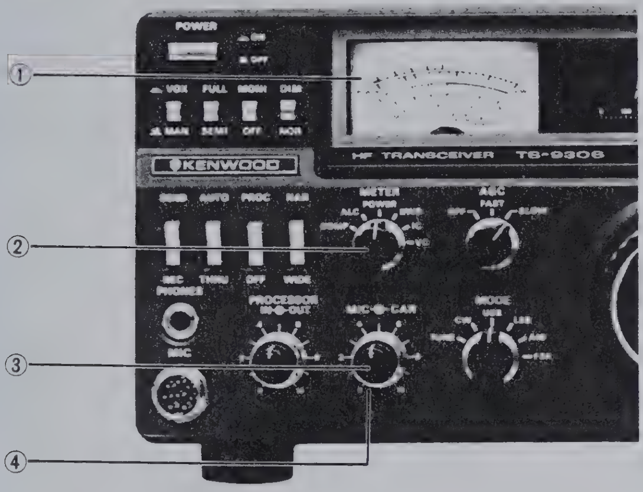


1 ANTENNA CONNECTOR
2 GND (ground terminal)
3 RX. ANT output switch
4 RX. ANT terminal
5 X. VERTER (transverter) terminal
6 REMOTE CONNECTOR
7 IF OUT jack (R)
8 PHONE PATCH jacks
9 RTTY KEY jack (T)
10 Power connector
11 AC FUSE
12 EXT. SP (speaker) jack (R)
13 CW. KEY jack (T)
14 Cooling fan (final section)
15 Cooling fan (power supply)

4.1 FRONT AND TOP PANELS

The symbol after the part name indicates:
R: Active only during reception
T: Active only during transmission
No symbol: Always active

[METER]



① **Meter**
The meter monitors seven different functions, depending on the METER switch position. In receive the meter is automatically an S-meter, and shows received signal strength on a scale of 0 to 60 dB over S9. In transmit, meter function depends on the position of the METER switch, as described below. This is an average-responding meter, NOT peak-reading.

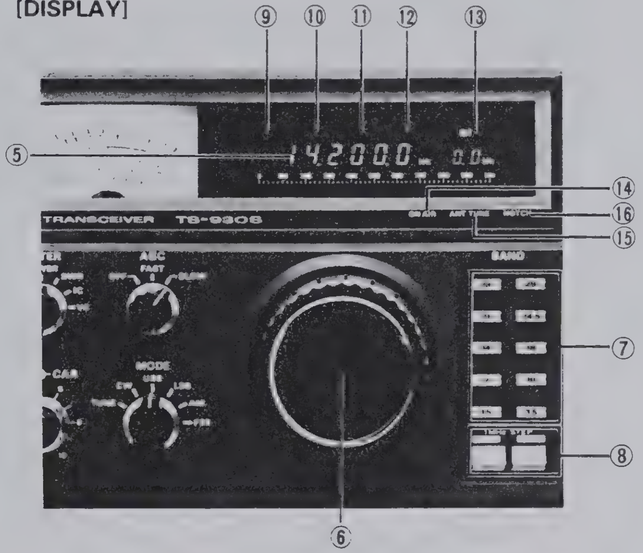
② **METER switch (T)**
This determines the transmit meter function:

- COMP:
  This indicates compression level when the speech processor is operating. Do not exceed 10 dB compression.
- **ALC (Automatic Level Control):**
  Monitors internal ALC voltage, or the ALC voltage feedback from a linear amplifier operated in conjunction with the TS-930S. For SSB operation the ALC reading for voice peaks should be within the indicated ALC range. ALC voltage adjustment is made with the MIC control for SSB and with the CAR control for CW.
  In FSK or when the processor is operating, adjust ALC with the PROCESSOR OUT control (41).
- POWER:
  Indicates transmitter RF output power.
- SWR:
  Indicates voltage standing wave ratio (VSWR).
- IC:
  Indicates the power transistor collector current (IC).
  Since the IC meter is adjusted to the values in the proximity of the current value which is usually used, its indication may not be correct when a weak current such as the idling current is applied.
- VC:
  Indicates the power transistor collector voltage (VC).

③ **MIC (microphone gain) control (T)**
This control adjusts microphone amplifier gain for SSB operation. Adjust for an on-scale ALC reading on voice peaks. For low-power operation, adjust this control below the ALC range.

④ **CAR (carrier level) control (T)**
This controls carrier level during CW operation. Adjust the carrier level for an on-scale ALC meter reading. For low-power operation, adjust this control below the ALC range.

[DISPLAY]



⑤ **Frequency display**
This custom two color gas display tube independently indicates: Operating frequency to the 100 Hz place, and RIT frequency, up to +/− 9.9 kHz offset. An analog-type dial displays in 20 kHz steps.
By mode, the display indicates:

TUNE:	Zero-beat frequency
CW, USB, LSB:	Transmit carrier frequency.
AM:	Filter center frequency.
FSK:	Space frequency.

⑥ **Main Tuning knob**
This flywheel-weight knob controls the dual digital VFO's, which operate in 10 Hz step at 10 kHz/turn for normal slow tuning. When the knob is spun fast, the tuning rate automatically increases for fast QSY.

⑦ **BAND switch**
This selects one of the 10 HF amateur radio bands between 1.9 MHz and 29.7 MHz. The 1 MHz step switches (8) allow raising or lowering frequency in 1 MHz steps from 150 kHz to 29.9 MHz. WWV may be tuned at 5, 10, 15, or 20 MHz.

Note:
As supplied, reception only is possible on the 10, 18, and 24.5 MHz bands.

⑧ 1 MHz step switches

These raise or lower frequency in 1 MHz steps within the transceivers full frequency range. Depress UP to raise frequency and DOWN to lower frequency.

⑨ DIAL LOCK indicator

This lights when DIAL LOCK switch (57) is on.

⑩ VFO A indicator

This lights when VFO A is operating.

⑪ VFO B indicator

This lights when VFO B is operating.

⑫ MEMO (memory) indicator

This lights to indicate operation on a fixed memory channel frequency when the VFO/MEMO switch (20) is depressed to MEMO.

⑬ RIT indicator (R)

This lights when the RIT switch (27) is on.

⑭ ON AIR indicator (T)

This lights during transmission mode.

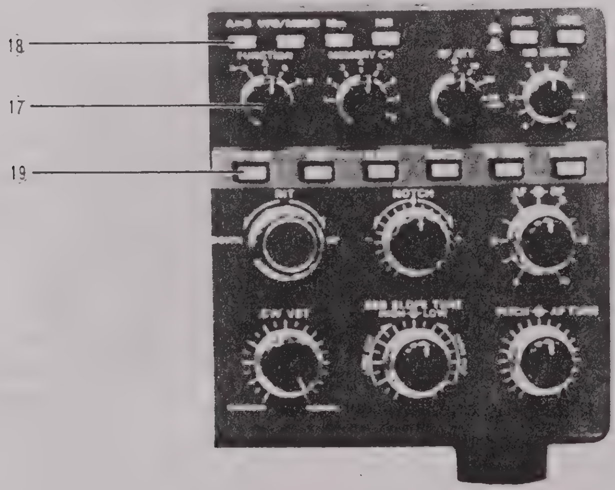
⑮ ANT TUNE (antenna tuner) indicator (T)

This indicates Auto Antenna Tuner operation and lights only when the Auto Antenna Tuner switch (46) is at AUTO, the mode switch is in Tune, carrier is inserted in transmit mode and the motors are running.

⑯ NOTCH indicator (R)

This indicates the notch filter is operating and lights when the NOTCH switch (30) is on.

[VFO operation]



⑰ FUNCTION switch

This selects receive and transmit frequencies. Select position A or B for normal operation.

- **A-R:**
  VFO A operates during reception and VFO B during transmission.
- **A:**
  VFO A operates, VFO B stands by.
- **B:**
  VFO B operates, VFO A stands by.
- **B-R:**
  VFO B operates during reception and VFO A during transmission.

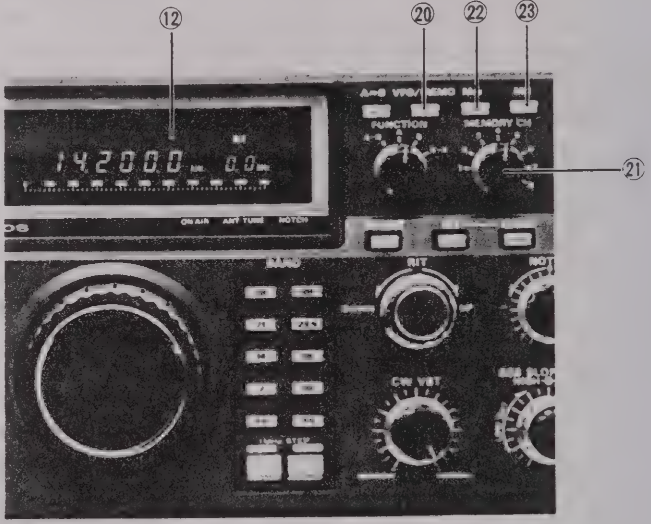
⑱ A = B switch

Depress this switch to equalize the frequency of the idle VFO to that of the operating VFO.

⑲ TF-SET switch

Depress this switch to "SPOT", or momentarily interchange reception frequency with transmission frequency. Frequency "SPOTTING" is possible only in receive and is ineffective during transmission.

[MEMORY]



⑳ VFO/MEMO (memory) switch

This selects either VFO or MEMO (memory). At MEMO, the MEMO (memory) indicator (12) lights.

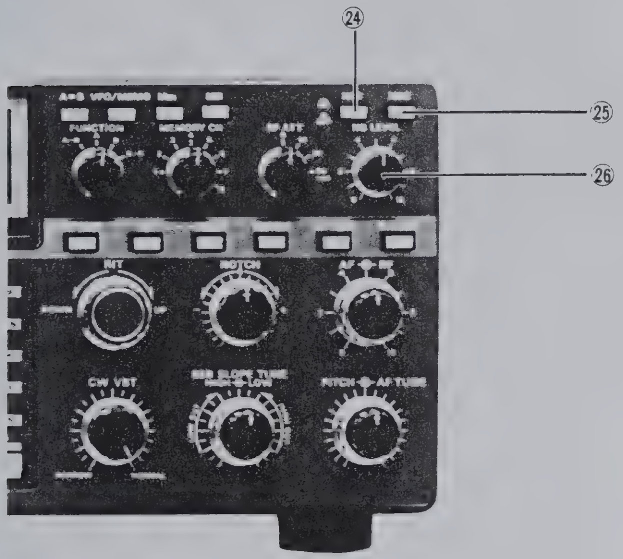
㉑ MEMORY CH selector

This selects one of the eight memory channels. To write in a frequency depress the Min switch and the displayed frequency will store in the selected channel. To recall from a memory channel, select the channel and depress the MR switch.

㉒ Min (memory write) switch
Use this to memorize a frequency into a selected channel.

㉓ MR (memory recall) switch
Use this switch to recall a memorized frequency.

[NOISE BLANKERS]

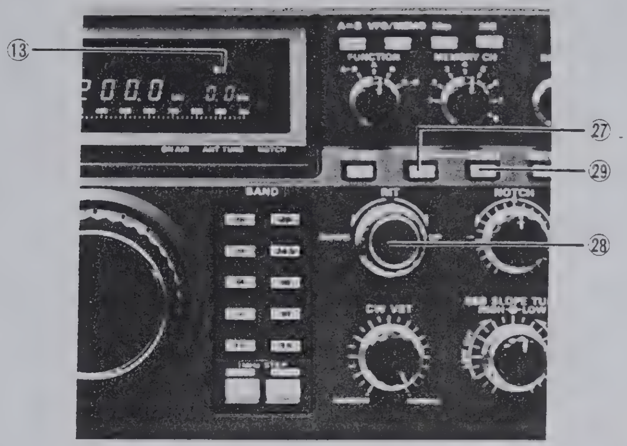


㉔ NB 1 (noise blanker 1) switch (R)
The noise blanker suppresses impulse noises such as automotive ignition noise, and permits otherwise unreadable weak signals to be received. The NB LEVEL control (25) varies the operating level of the noise blanker.

㉕ NB LEVEL control (R)
This sets the noise blanker operating level. Use only the minimum level necessary, according to operating conditions and noises. Excessive N.B. level will cause distortion or clipping.

㉖ NB 2 (noise blanker 2) switch (R)
Turn on NB 2 if "woodpecker" radar pulse noise is the source of interference. Note that when NB 2 operates, signal blanking time is longer than during NB 1 operation. The blanking "hole" will be apparent on the signal. This is not a symptom of trouble. The NB 2 switch actually operates both NB 1 and NB 2 simultaneously. It is recommended that you turn this switch OFF when there is no "woodpecker" noise.

[RIT]

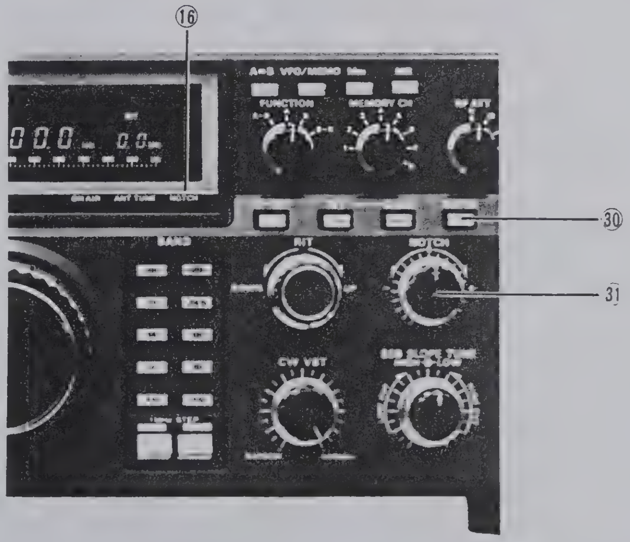


㉗ RIT switch (R)
This controls the Receiver Incremental Tuning (RIT) circuit. When this switch is on, the RIT indicator (13) lights.

㉘ RIT control (R)
This permits independently varying the receive from the transmit frequency, up to +/−9.9 kHz, when the RIT is on. The RIT frequency is independently displayed to the 100 Hz order.

㉙ RIT-CLEAR switch (R)
This resets the RIT frequency to zero offset.

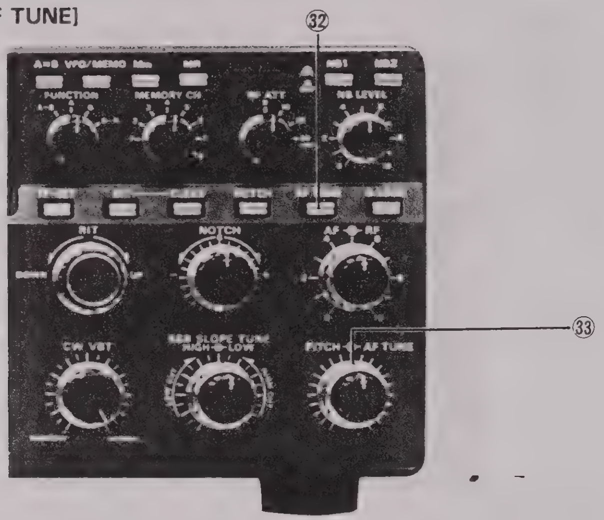
[NOTCH filter]



㉚ NOTCH switch (R)
This switch controls the NOTCH circuit and indicator.

㉛ NOTCH control (R)
Turn the NOTCH switch ON to activate the Notch filter. Adjust the notch frequency to null beat (carrier interference) signals.

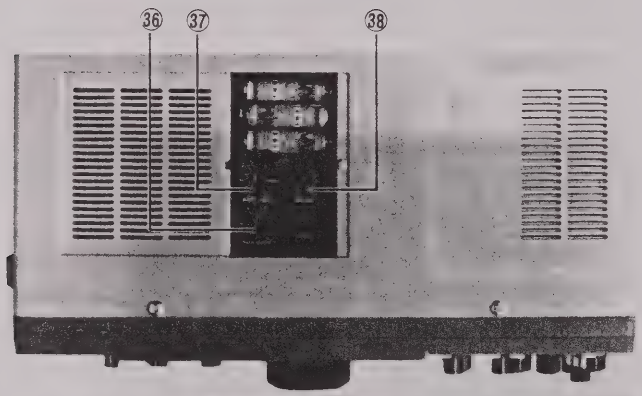
[AF TUNE]

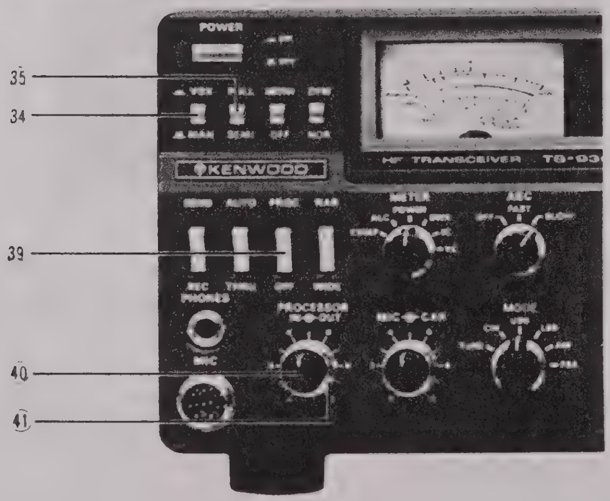


㉜ **AF TUNE switch (R)**
During CW reception, this circuit provides a tuneable, peaked AF response. Undesirable signals will be attenuated, while the desired CW signal will be peaked. The AF TUNE control (33) adjusts the peak frequency.

㉝ **AF TUNE control (R)**
With the AF tune switch (32) ON, adjusts this for the desired AF peak response.

[VOX & SPEECH PROCESSOR]





㉞ **VOX switch (T)**
Turn this switch on to activate the VOX (Voice Operated Xmit) during SSB operation or break-in during CW operation.

㉟ **CW break-in selector (T)**
During CW operation, this selects either full break-in (receives between keyed characters) at FULL, or semi break-in (holds transmitter on for preset delay by Delay control (38)) at SEMI.

㊱ **VOX GAIN (T)**
This controls sensitivity of the VOX (Voice Operated Transmit) circuit. Adjust the gain for consistent key-over by voice, but not back ground noise.

㊲ **ANTI VOX control (T)**
During VOX operation, the VOX may be operated by sound from the transceiver's speaker. Use just enough antivox to prevent speaker sound from tripping the VOX. ANTI VOX does not operate when headphones are plugged in on the front panel.

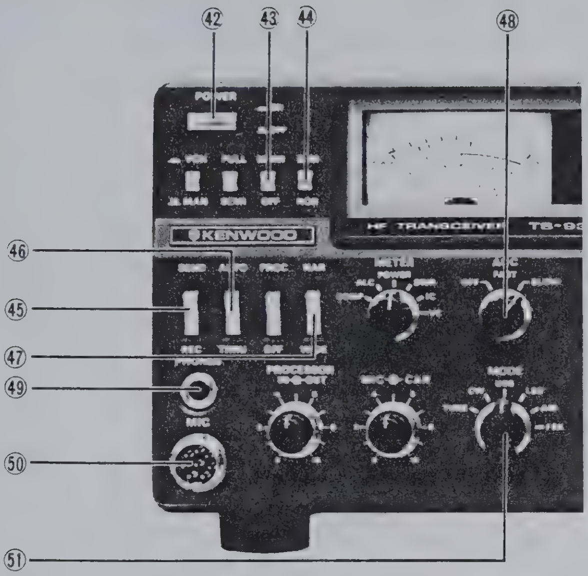
㊳ **DELAY control (T)**
This controls hold time for SSB VOX, or CW semi-break-in operation. Adjust to hold the transmitter on between words, at a normal rate of speech, or keying speed.

㊴ **PROC (SPEECH PROCESSOR) SWITCH (T)**
This switch is used during SSB operation. Set the switch to the ON position and the speech processor will be activated, increasing average "talk power". Compression level can be adjusted by the processor controls.

㊵ **PROCESSOR-IN (input level) control (T)**
This control adjusts compression level. Set the meter switch (2) to the COMP position and adjust this control while observing the meter COMP scale. It is suggested that 10 dB or less compression be used. Use the MONITOR, or an oscilloscope, when adjusting the compression level.

㊶ **PROCESSOR-OUT (output level) control (T)**
This varies the speech processor output level. Adjust for an on-scale ALC reading at voice peaks.

[OTHER CONTROLS]



㊷ MAIN POWER switch

Controls all power to the transceiver. Before operating the POWER switch, confirm that the VOX (34) is off, and the standby switch (45) is set to the reception mode.

㊸ MONI (MONITOR) SWITCH (T)

This delivers a sample of the demodulated transmit IF signal to the AF circuit for monitoring modulation during SSB operation.

㊹ DIM (dimmer) switch

For operator convenience, this switch selects either bright or dim intensity of both the digital display, and meter illumination.

㊺ STAND-BY SWITCH (T)

This two-position level switch selects:

- **REC:**
  The transceiver is receiving unless the microphone PTT switch, or the VOX circuit is activated.
- **SEND:**
  Locks the unit in transmit.
  Transmission is locked out (reception only) if the selected transmission frequency is outside the amateur radio bands, or the final stage thermal-protects (is deactivated due to excessive heat-sink temperature).

㊻ Auto Antenna Tuner switch (T)

- **AUTO:**
  The Auto Antenna Tuner will operate during transmission in the tune mode, with carrier inserted.
- **THRU:**
  The Auto Antenna Tuner is deactivated and bypassed during transmission.
  When the AUTO mode is selected and the ANT TUNE indicator (15) is lit, the two variable capacitor drive motors are operating. Wait until the indicator goes off before switching to an operating mode.

㊼ NAR/WIDE filter selector (R)

This switches the IF bandwidth to narrow from the normal wide position. (Narrow filters are optional.) This switch does not operate in SSB mode.

㊽ AGC SWITCH (R)

This controls the AGC (Automatic Gain Control) circuit:

- **OFF:**
  AGC disabled (no AGC).
- **FAST:**
  Normally used for CW and FSK operation.
- **SLOW:**
  Normally used for SSB and AM operation.

㊾ PHONES JACK (R)

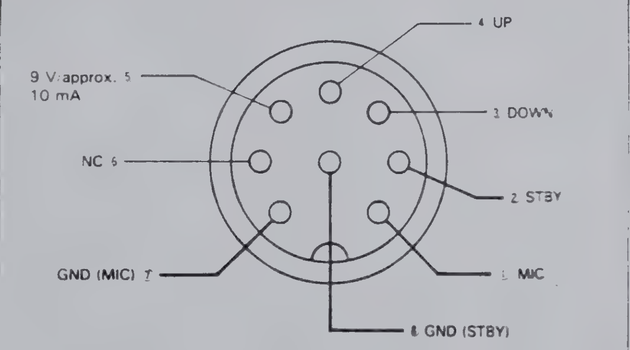
The headphones jack allows use of a 4 to 16 ohm headphone through a 1/4″ phone plug. When phones are used the speaker and antivox are disabled.

㊿ MIC (microphone) connector (8 Pins) (T)

Microphone audio input. Frequency UP/DOWN control and PTT lines are included. The optional MC-60A is recommended. Pin assignments of the MIC connector are shown below.

Note:

When operating the microphone, be sure that the MC-60A MIC AMP switch is set to OUT.

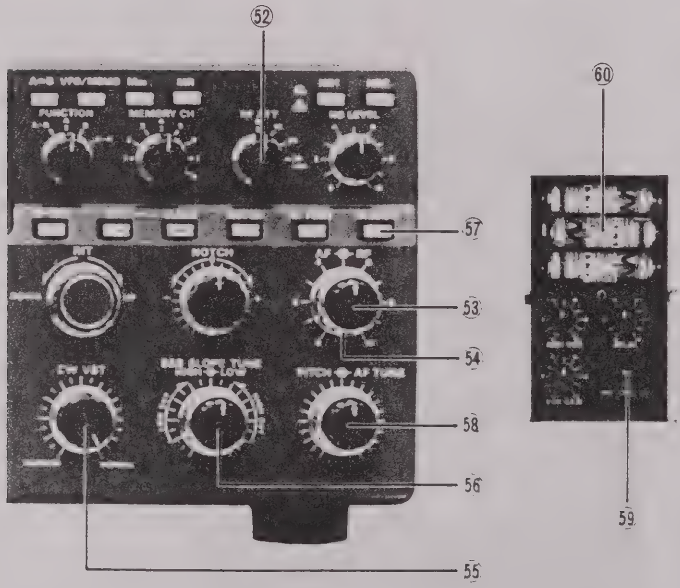


FRONT VIEW

(51) MODE SWITCH

The mode switch selects type of emission, and TUNE.

- **TUNE:**
  Always use this position to make antenna tuning and initial linear amplifier tune-up adjustments. Input power to the final amplifiers is reduced approximately 50% to protect the final power transistors from possible damage during adjustments. The key circuit is locked-on and the key is disabled.
- **CW:**
  Select this position for CW operation. If a key is connected it must be closed to obtain transmitter output.
- **USB:**
  Used for upper-sideband operation. International Amateur practice dictates the use of USB on and above the 10 MHz band.
- **LSB:**
  Selects lower-sideband. International Amateur practice dicates the use of LSB on and below the 7 MHz band.
- **FSK:**
  RTTY operation is available with a terminal unit and teletypewriter.
- **AM:**
  Select this position for AM operation.



(52) RF ATT (RF attenuator) switch (R)

This switch permits insertion of 10, 20, or 30 dB attenuator in the receiver antenna circuit, to protect the RF amplifier and mixer from excessive input signal distortion.

(53) AF GAIN (R)

This adjusts receiver audio level. Volume increases clockwise.

(54) RF GAIN (R)

This adjusts receiver RF amplifier gain. Turn fully clockwise for maximum gain and a correct S-meter reading.

(55) CW VBT CONTROL (R)

The CW VBT (Variable Bandwidth Tuning) continuously adjusts the IF Filter bandwidth to eliminate radio interference. For normal operation, this control may be left fully clockwise (NORMAL Position). If a narrow filter is selected in either the CW, TUNE, FSK, or AM mode, the rate of bandwidth change is reduced for a vernier effect. Normally the control may remain fully clockwise. Without an optional filter, the circuit is effective only when WIDE is selected during CW, TUNE, or FSK, or when NAR is selected during AM operation.

(56) SSB SLOPE TUNE control (R)

This permits independently varying the upper and lower IF bandwidths. High and low audio frequencies may be simultaneously cut (tuned). Optimum IF bandwidth may be selected according to interference conditions. This circuit operates only in the SSB mode.

(57) D. (DIAL) LOCK switch

This push button electrically locks the frequency of the working VFO. When this switch is on, the tuned frequency does not vary when either the tuning knob or BAND switch is operated. This is convenient when operating on the same frequency for extended periods. The RIT does operate with the D. LOCK switch on. The D. LOCK indicator (9) lights to show operation.

(58) CW PITCH control

This permits control of pitch during CW reception. During transmission, this control simultaneously adjusts CW side tone frequency to match that of the received signal.

(59) CAL (marker) switch (R)

In the ON position, receive frequency can be calibrated at 100 kHz intervals using the built-in oscillator. The marker is also used when calibrating the internal master reference oscillator. See Figure 8-3 for location and calibration instruction.

(60) Battery compartment

Three AA type manganese or alkaline dry cells may be installed for memory backup. Service life of the cells is about one year. If the transceiver is to be stored, it is recommended that the dry cells be removed.

Model TS-930S

Serial No.

Date of Purchase

Dealer

A product of

TRIO-KENWOOD CORPORATION

17-5, 2-chome, shibuya, shibuya-ku Tokyo 150, Japan

TRIO-KENWOOD COMMUNICATIONS

1111 West Walnut Street, Compton California 90220, U.S.A

TRIO-KENWOOD COMMUNICATIONS, GmbH

D-6374 Steinbach TS, Industriestrasse 8A, West Germany

TRIO-KENWOOD ELECTRONICS, N.V.

Leuvensesteenweg 504 B-1930 Zaventem, Belgium

TRIO-KENWOOD (AUSTRALIA) PTY. LTD.

4E Woodcock Place, Lane Cove N.S.W. 2066, Australia

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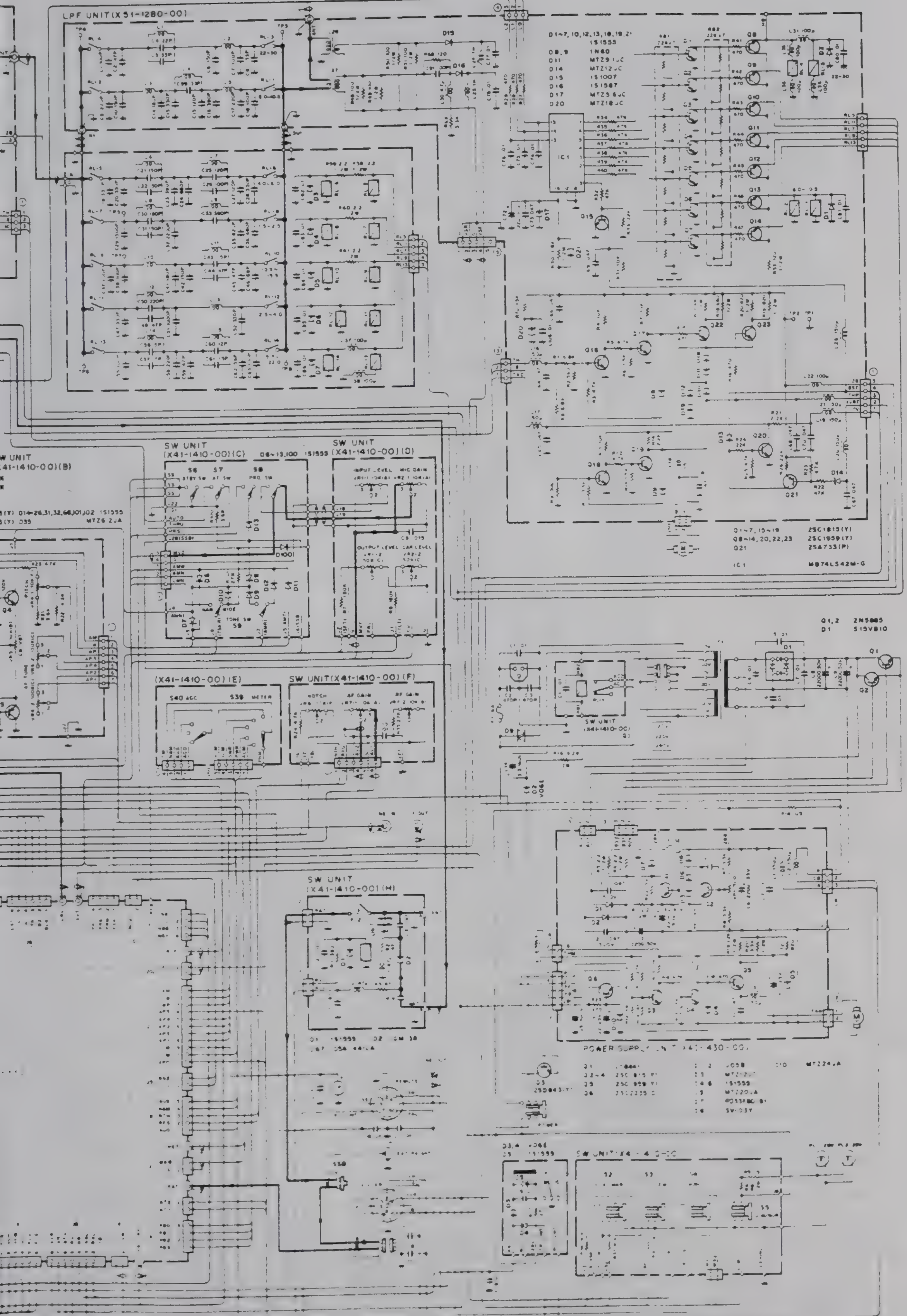
LPF UNIT(X51-1280-00)
D1~7,10,12,13,18,19,21 1S1555
D8,9 1N60
D11 MTZ9.1JC
D14 MTZ12JC
D15 1S1007
D16 1S1587
D17 MTZ5.6JC
D20 MTZ18JC
IC1
Q8
Q9
Q10
Q11
Q12
Q13
Q14
Q15
Q16
Q18
Q20
Q21
Q22
Q23
D14
Q1~7, 15~19 2SC1815(Y)
Q8~14, 20, 22, 23 2SC1959(Y)
Q21 2SA733(P)
IC1 M874LS42M-G
SW UNIT (X41-1410-00)(B)
SW UNIT (X41-1410-00)(C)
D8~13,100 1S1555
SW UNIT (X41-1410-00)(D)
S6 STBY SW
S7 AT SW
S8 PRO SW
INPUT LEVEL
MIC GAIN
OUTPUT LEVEL
CAR LEVEL
D1001
TONE SW
S9
D14~26,31,32,68,101,102 1S1555
D35 MTZ6.2JA
PITCH
Q4
(X41-1410-00)(E)
S40 AGC
S39 METER
SW UNIT(X41-1410-00)(F)
NOTCH
AF GAIN
RF GAIN
Q1,2 2N5885
D1 S15VB10
Q1
Q2
SW UNIT (X41-1410-00)(G)
D9
SW UNIT (X41-1410-00)(H)
D1 1S1555
D2 SM 38
POWER SUPPLY UNIT (X43-1430-00)
Q1
Q2~4
Q5
Q6
Q3
M
MTZ24JA
MTZ20JA
1S1555
SW-05Y
SW UNIT (X41-1410-00)
Q6
Q5
D3,4
D5 1S1555
S2
S3
S5
T
T

Model TS-930S

Serial No.

Date of Purchase

Dealer

A product of

TRIO-KENWOOD CORPORATION

17-5, 2-chome, shibuya, shibuya-ku Tokyo 150, Japan

TRIO-KENWOOD COMMUNICATIONS
1111 West Walnut Street, Compton, California 90220, U.S.A
TRIO-KENWOOD COMMUNICATIONS, GmbH
D-6374 Steinbach TS, Industriestrasse 8A, West Germany
TRIO-KENWOOD ELECTRONICS, N.V.
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TRIO-KENWOOD (AUSTRALIA) PTY. LTD.
4E Woodcock Place, Lane Cove N.S.W. 2066, Australia

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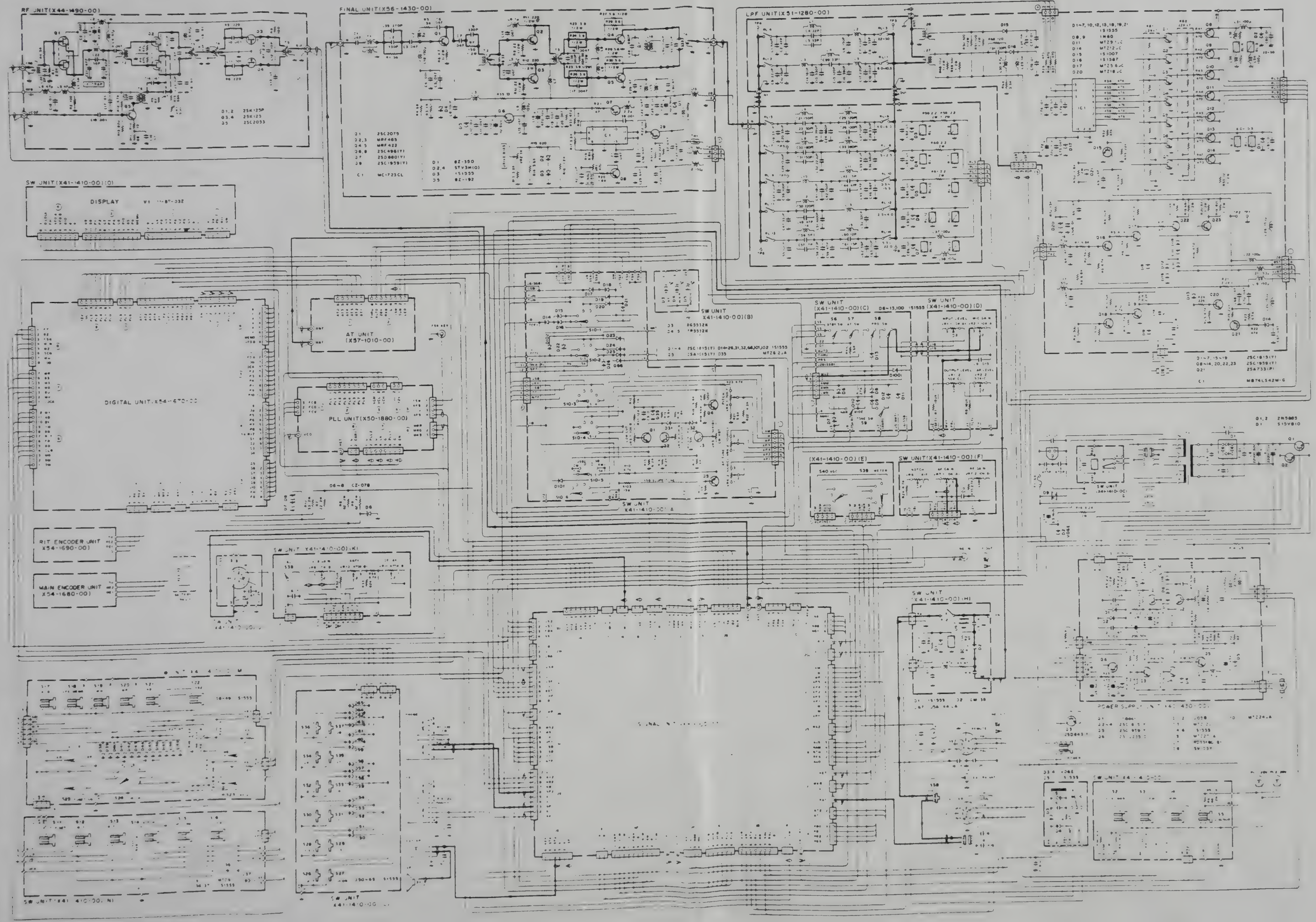
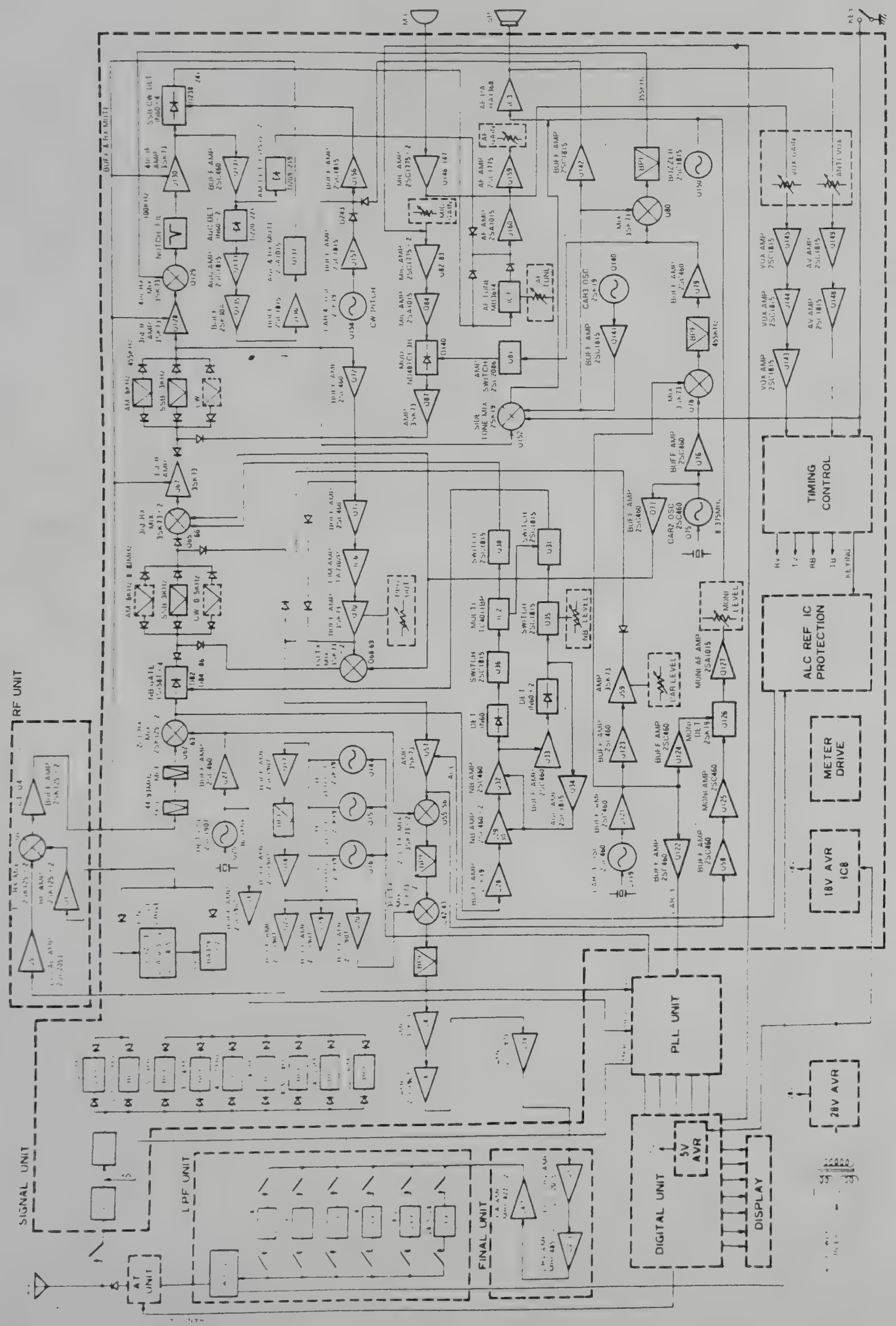
SECTION 12. CIRCUIT DIAGRAMS

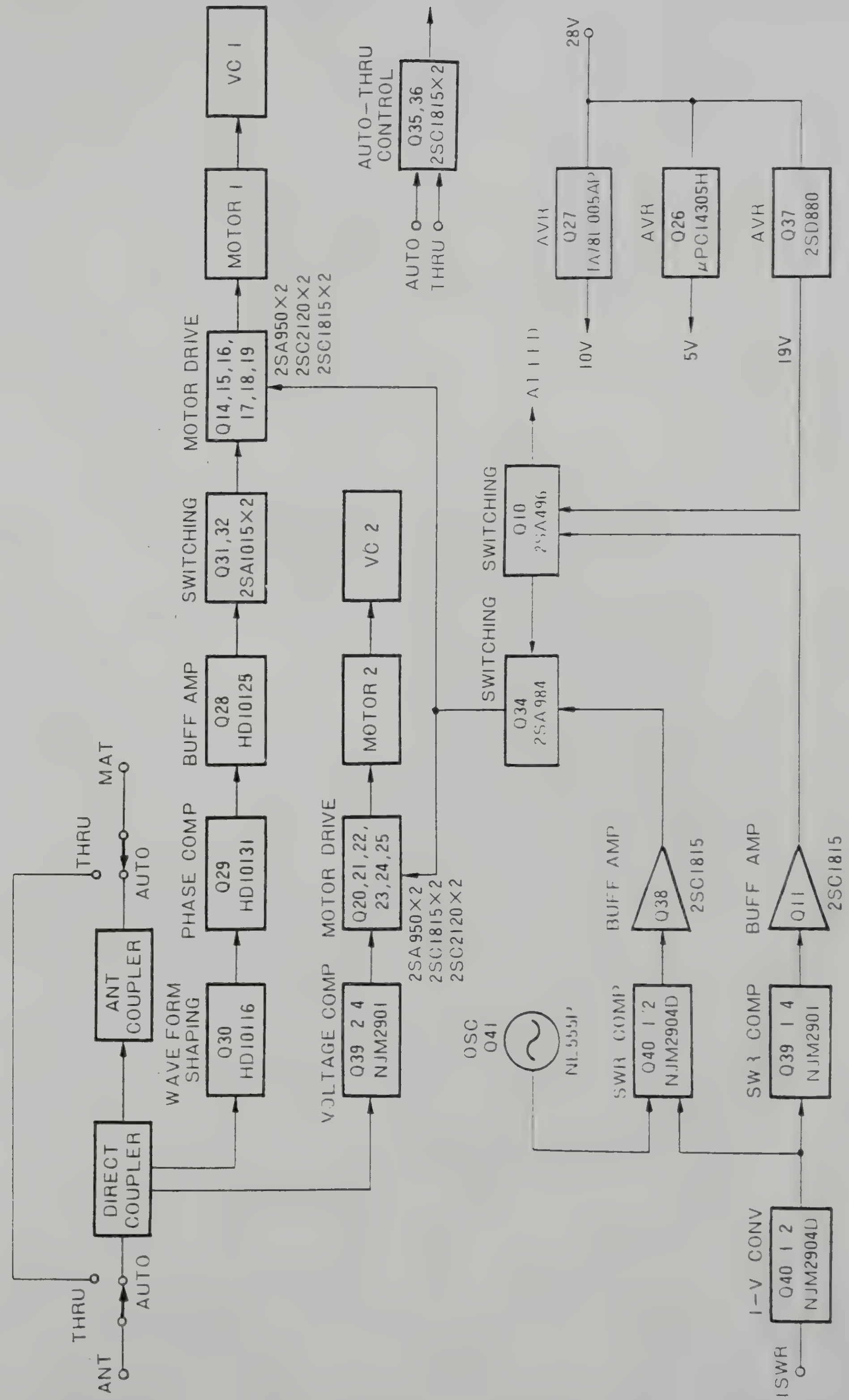
SCHEMATIC DIAGRAM


RF UNIT(X44-1490-00)
Q1,2 2SK125P
Q3,4 2SK125
Q5 2SC2053
FINAL UNIT(X56-1430-00)
Q1 2SC2075
Q2,3 MRF485
Q4,5 MRF422
Q6,8 2SC496(Y)
Q7 2SD880(Y)
Q9 2SC1959(Y)
IC1 MC1723CL
D1 BZ-350
D2,4 STV3H(O)
D3 1S1555
D5 BZ-192
LPF UNIT(X51-1280-00)
D1~7,10,12,13,18,19,21 1S1555
D8,9 1N60
D11 MTZ9.1JC
D14 MTZ12JC
D15 1S1007
D16 1S1587
D17 MTZ5.6JC
D20 MTZ18JC
Q1~7,15~19 2SC1815(Y)
Q8~14,20,22,23 2SC1959(Y)
Q21 2SA733(P)
IC1 MB74LS42M-G
SW UNIT(X41-1410-00)(O)
DISPLAY
DIGITAL UNIT(X54-1670-00)
AT UNIT
(X57-1010-00)
PLL UNIT(X50-1880-00)
SW UNIT
X41-1410-00)(B)
SW UNIT
(X41-1410-00)(C)
SW UNIT
(X41-1410-00)(D)
(X41-1410-00)(E)
SW UNIT(X41-1410-00)(F)
SW UNIT
X41-1410-00)(A)
SW UNIT
(X41-1410-00)(H)
SW UNIT X41-1410-00)(K)
RIT ENCODER UNIT
X54-1690-00)
MAIN ENCODER UNIT
X54-1680-00)
D6~8 CZ-078
SW UNIT(X41-1410-00)(N)
SW UNIT
X41-1410-00
POWER SUPPLY UNIT (X43-1430-00)
Q1,2 2N5885
D1 S15VB10

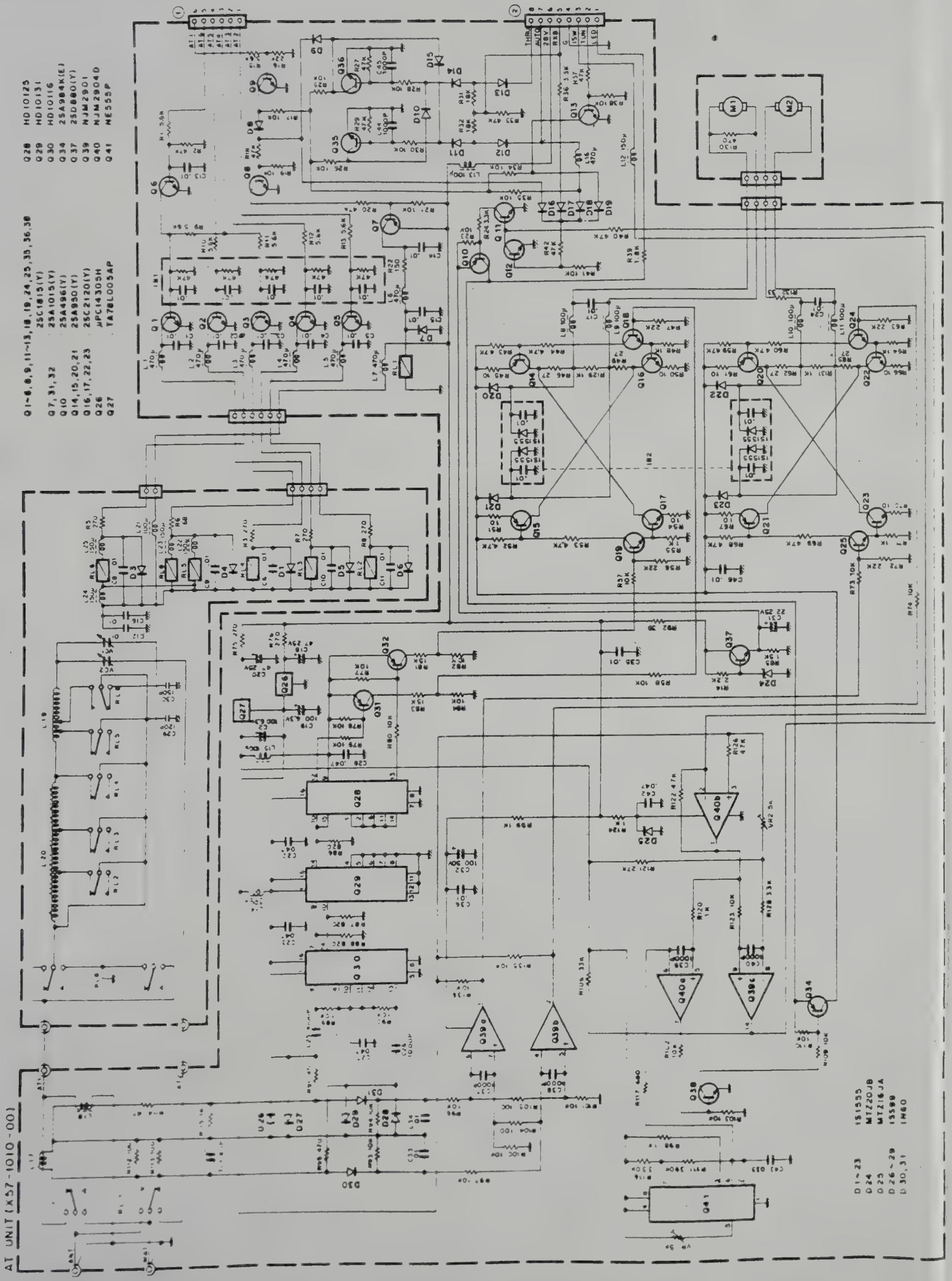
SECTION 11. BLOCK DIAGRAMS


RF UNIT
SIGNAL UNIT
LPF UNIT
FINAL UNIT
AT UNIT
DIGITAL UNIT
5V AVR
DISPLAY
PLL UNIT
28V AVR
18V AVR IC8
METER DRIVE
ALC REF IC PROTECTION
TIMING CONTROL

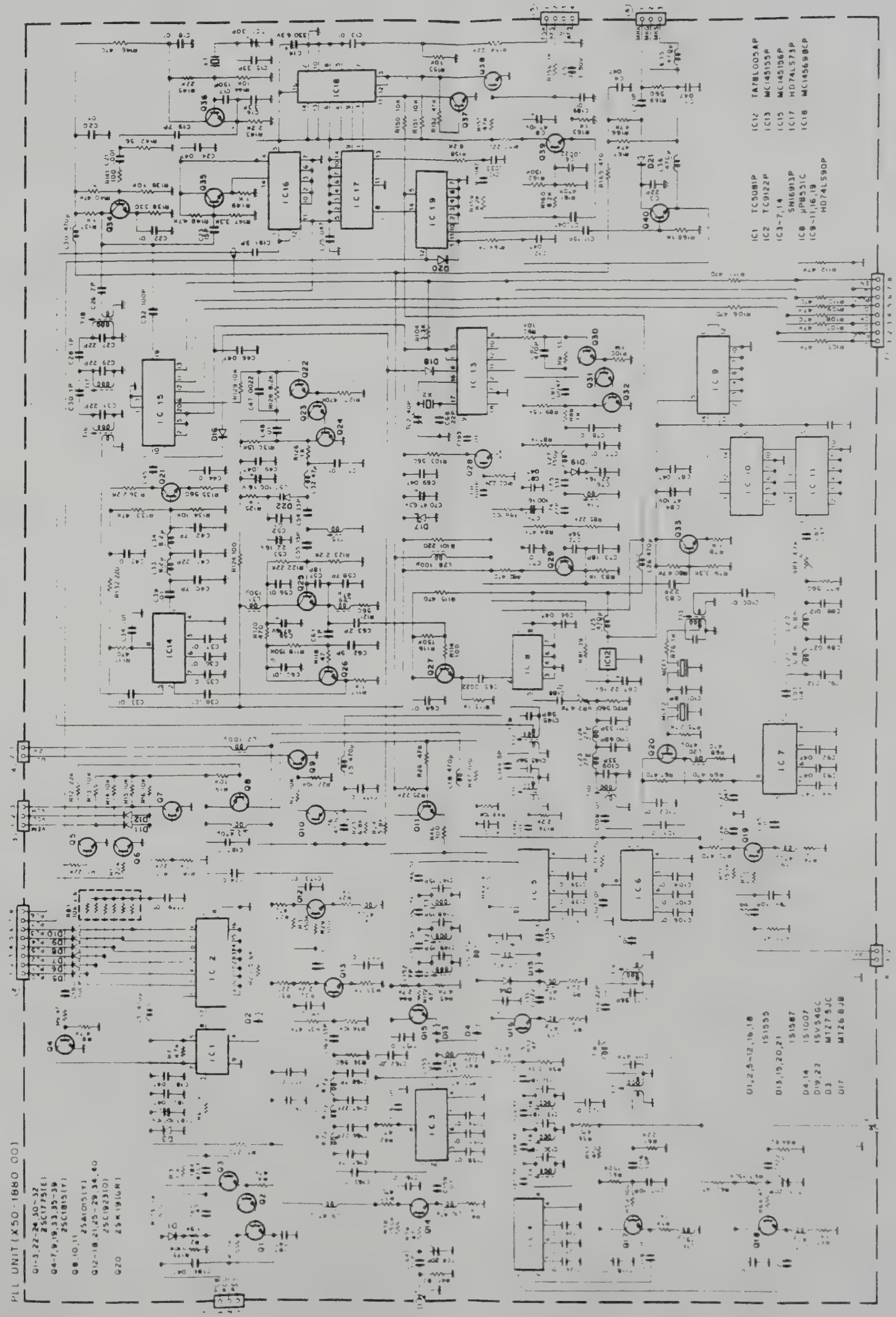
11.2 AT-930 BLOCK DIAGRAM


VC 1
MOTOR 1
MOTOR DRIVE
Q14,15,16,17,18,19
2SA950×2
2SC2120×2
2SC1815×2
SWITCHING
Q31,32
2SA1015×2
BUFF AMP
Q28
HD10125
PHASE COMP
Q29
HD10131
WAVE FORM SHAPING
Q30
HD10116
ANT COUPLER
DIRECT COUPLER
THRU
AUTO
MAT
ANT
VC 2
MOTOR 2
MOTOR DRIVE
Q20,21,22,23,24,25
2SA950×2
2SC1815×2
2SC2120×2
VOLTAGE COMP
Q39 2 4
NJM2901
AUTO-THRU CONTROL
Q35,36
2SC1815×2
AUTO
THRU
28V
AVR
Q27
TA78L005AP
10V
AVR
Q26
μPC14305H
5V
AVR
Q37
2SD880
19V
AT TTD
SWITCHING
Q10
2SA496
SWITCHING
Q34
2SA984
BUFF AMP
Q38
2SC1815
BUFF AMP
Q11
2SC1815
OSC
Q41
NE555P
SWR COMP
Q40 1 2
NJM2904D
SWR COMP
Q39 1 4
NJM2901
I-V CONV
Q40 1 2
NJM2904D
ISWR

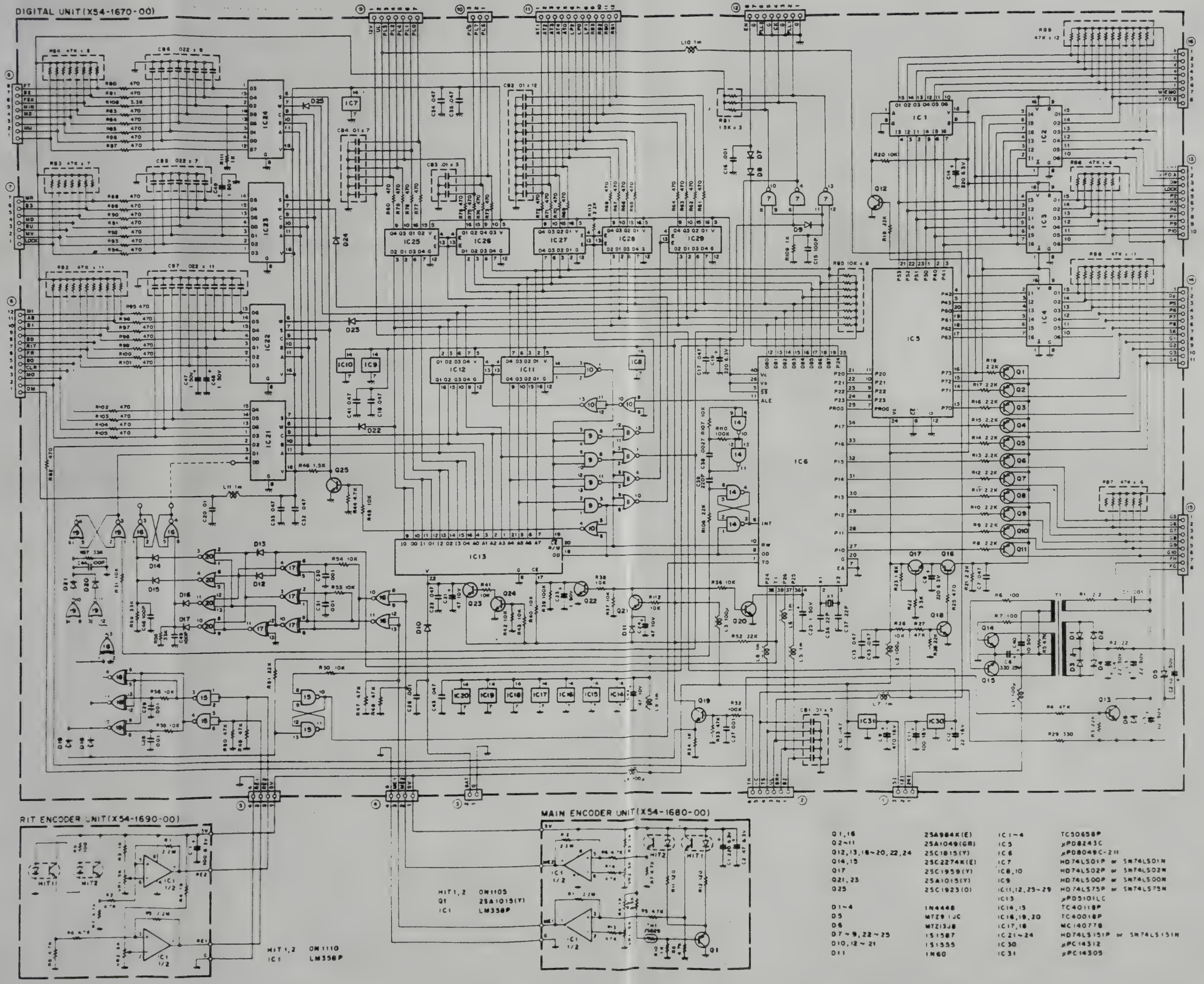
AT UNIT (X57-1010-00)


Q1~6,8,9,11~13,18,19,24,25,33,36,38 2SC1815(Y)
Q7,31,32 2SA1015(Y)
Q10 2SA496(Y)
Q14,15,20,21 2SB950(Y)
Q16,17,22,23 2SC2120(Y)
Q26 μPC14305H
Q27 TA78L005AP
Q28 HD10125
Q29 HD10131
Q30 HD10116
Q34 2SA984K(E)
Q37 2SD880(Y)
Q39 NJM2901
Q40 NJM2904D
Q41 NE555P
D1~23 1S1555
D24 MTZ20JB
D25 MTZ16JA
D26~29 1S5599
D30,31 1N60
AT UNIT (X57-1010-00)

PLL UNIT (X50-1880-00)


IC1 TC5081P
IC2 TC9122P
IC3~7,14 SN16913P
IC8 μPB551C
IC9~11,16,19 HD74LS90P
IC12 TA78L005AP
IC13 MC14515SP
IC15 MC14515GP
IC17 HD74LS73P
IC18 MC14569BCP
D1,2,5~12,16,18 1S1555
D13,15,20,21 1S1587
D4,14 1S1007
D19,22 1SV54GC
D3 MTZ7.5JC
D17 MTZ6.8JB
PLL UNIT (X50-1880-00)
Q1~3,22~24,30~32 2SC1775(E)
Q4~7,9,19,33,35~39 2SC1815(Y)
Q8,10,11 2SA1015(Y)
Q12~18,21,25~29,34,40 2SC1923(O)
Q20 2SK19(GR)

DIGITAL UNIT (X54-1670-00)


DIGITAL UNIT(X54-1670-00)
RIT ENCODER UNIT(X54-1690-00)
MAIN ENCODER UNIT(X54-1680-00)
IC1
IC2
IC3
IC4
IC5
IC6
IC7
IC8
IC9
IC10
IC11
IC12
IC13
IC14
IC15
IC16
IC17
IC18
IC19
IC20
IC21
IC22
IC23
IC24
IC25
IC26
IC27
IC28
IC29
IC30
IC31
HIT1,2 OM1105
Q1 2SA1015(Y)
IC1 LM358P
HIT1,2 OM1110
IC1 LM358P

Q1,16	2SA984K(E)	IC1~4	TC5065BP
Q2~11	2SA1049(GR)	IC5	μPD8243C
Q12,13,18~20,22,24	2SC1815(Y)	IC6	μPD8049C-211
Q14,15	2SC2274K(E)	IC7	HD74LS01P or SN74LS01N
Q17	2SC1959(Y)	IC8,10	HD74LS02P or SN74LS02N
Q21,23	2SA1015(Y)	IC9	HD74LS00P or SN74LS00N
Q25	2SC1923(O)	IC11,12,25~29	HD74LS75P or SN74LS75N
		IC13	μPD5101LC
D1~4	1N4448	IC14,15	TC4011BP
D5	MTZ9.1JC	IC16,19,20	TC4001BP
D6	MTZ13JB	IC17,18	MC14077B
D7~9,22~25	1S1587	IC21~24	HD74LS151P or SN74LS151N
D10,12~21	1S1555	IC30	μPC14312
D11	1N60	IC31	μPC14305

SECTION 9. TROUBLESHOOTING

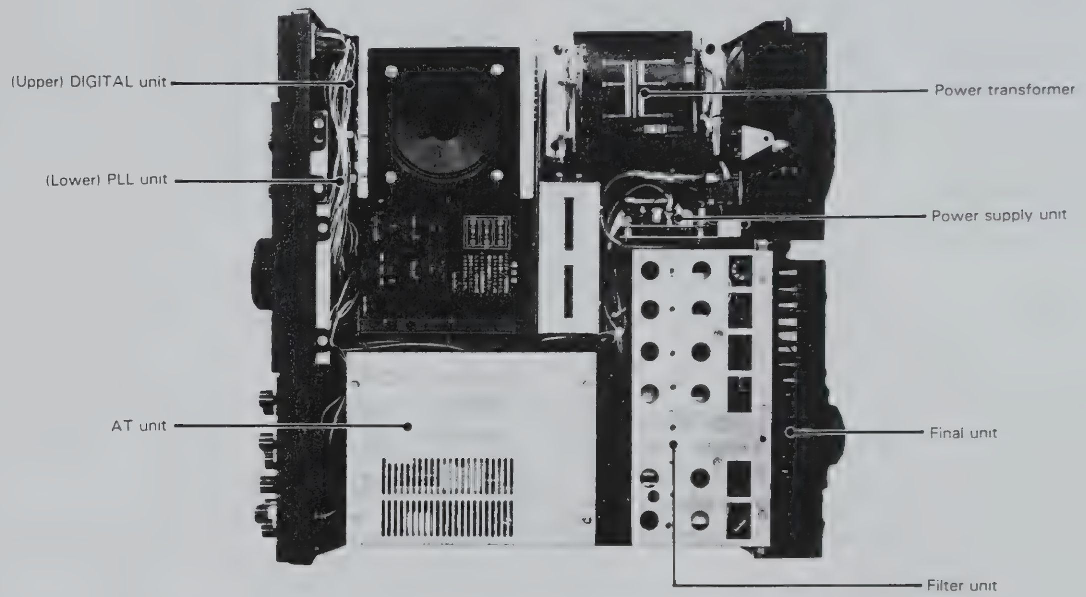
TRANSMITTER SECTION

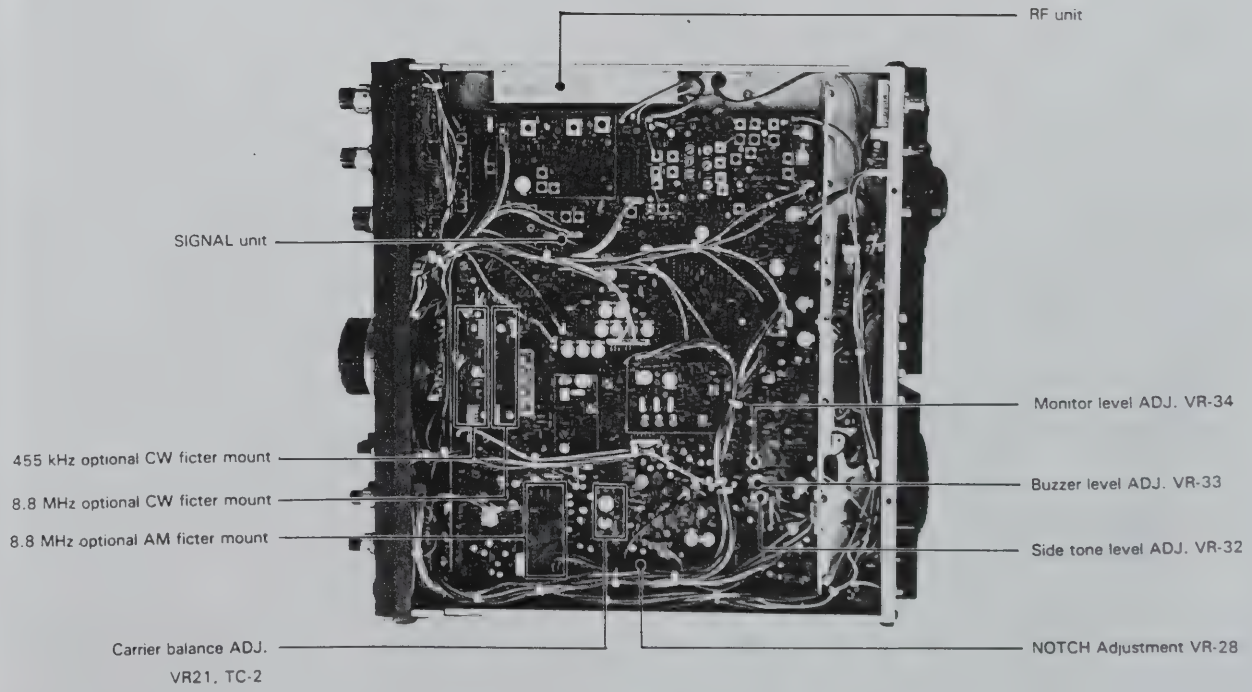
SYMPTOM	CAUSE	REMEDY
No output in SSB (No Ic.)	1. Open microphone cable or bad microphone 2. Low microphone gain. 3. PROC switch is to ON with PROC IN/OUT control fully counterclockwise.	1. Check the microphone. 2, Increase the mic Gain. 3. Increase the PROC IN/OUT settings.
VOX does not operate.	1. VOX GAIN control too low. 2. ANTI VOX control requires adjustment.	1. See section 5.4.7, VOX operation. 2. See section 5.4.7, VOX operation.
VOX trips by speaker output.	ANTI VOX control requires adjustment.	See section 5.4.7, VOX operation
Mic or radio chassis is ''hot'' during TX.	Excess RF in the shack. No earth ground, poor ground, or antenna is too close to the radio.	See section 3.8, 3.9.
Poor audio in SSB, TX-feedback.	Excess RF in the shack.	See section 3.8, 3.9.

RECEIVER SECTION

SYMPTOM	CAUSE	REMEDY
Lights do not light and there is no receiver noise when the POWER switch is turned on.	1. Bad power cable or connections. 2. Blown power supply fuse.	1. Check cables and connections. 2. Check for the cause of the blown fuse and replace the fuse.
An antenna is connected but no signals are heard.	Microphone PTT switch (or stand-by switch) is in the transmit position.	Release the PTT switch
An antenna is connected but S-meter deflects without a received signal.	1. RF GAIN control closed. 2. Low AC line voltage.	1. Open RF GAIN control. 2. Use a step-up transformer to raise the line voltage.
SSB signal unintelligible.	MODE switch is set to wrong sideband.	Turn MODE switch to the correct sideband.
RIT control inoperative.	RIT switch is off.	Push RIT button.
SSB received signal is extremely high cut or low cut.	Slope tuning is out of adjustment.	Set to the NORMAL position.

SECTION 10. INTERNAL VIEWS


(Upper) DIGITAL unit
(Lower) PLL unit
AT unit
Power transformer
Power supply unit
Final unit
Filter unit


RF unit
SIGNAL unit
455 kHz optional CW ficter mount
8.8 MHz optional CW ficter mount
8.8 MHz optional AM ficter mount
Carrier balance ADJ.
VR21, TC-2
Monitor level ADJ. VR-34
Buzzer level ADJ. VR-33
Side tone level ADJ. VR-32
NOTCH Adjustment VR-28

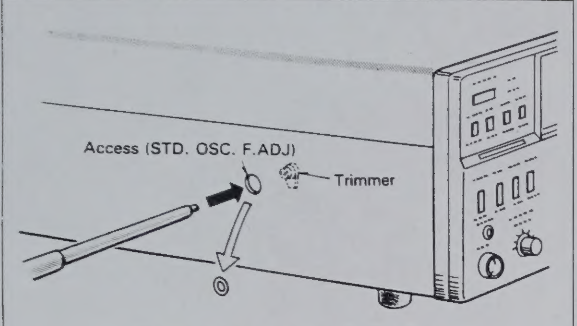


Fig. 8-3 Digital display calibration

5. Carrier balance adjustment (Signal unit)

With a 50 Ω dummy load connected to the ANT terminal, adjust for maximum output at 14.175 MHz. Reduce mic gain to zero. Set the transceiver in LSB mode. The power meter or an oscilloscope will deflect if the carrier is unbalanced. To balance the carrier, alternately adjust trimmer TC2 and trimpot VR-21 until the meter indicates minimum. Switch to USB mode and if the pointer deflects, readjust so the pointer deflects equally for both LSB and USB.

6. Side tone level adjustment (signal unit)

Adjust VR-32 for your preference.

7. "Buzzer" level adjustment (Signal unit)

Adjust VR-33 for your preference.

8. Monitor level adjustment (Signal unit)

Adjust VR-34 for your preference.

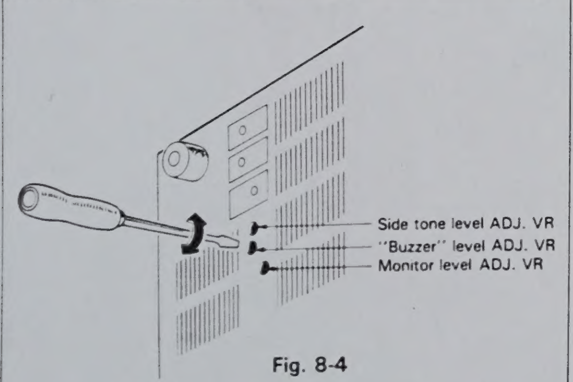


Fig. 8-4

9. S meter adjustment (Signal unit)

Disconnect the antenna with the transceiver in receive mode. Zero-point adjustment:
Adjust VR2 for meter pointer zero indication. If a standard signal generator (SSG) is available, adjust VR3 so the S-meter indicates "S-9", at 14.175 MHz for A 40 dB (50 μV) signal.

10. NOTCH adjustment (Signal unit)

Turn the MARKER switch on and tune for zero-beat in the TUNE mode.
Place the MODE switch to CW and turn the NOTCH switch on.
Adjust the NOTCH control to the 12 o'clock position and fine tune NOTCH for the notch point.
Adjust VR28 for minimum audio output. Repeat the NOTCH control and VR28 adjustments several times for best null.

8.3 MAINTENANCE

1. Semiconductors, resistors, and capacitors

Semiconductors are easily destroyed if a circuit is shorted. Troubleshoot carefully.
If a defective resistor or capacitor is to be replaced, use one of the same specifications.

2. Fuse

When the fuse blows, there is some cause. Be sure to find the cause before attempting operation. Use a 6 amp fuse for the TS-930S, or a 4 A fuse for the TS-930V for 120 V AC operation. Under no circumstances use a higher amperage fuse than specified. This can cause extensive damage. Also, the warranty will be void if an oversized fuse is used.

3. Fan motor lubrication

Every 6 months apply a drop of light machine oil to the front and rear fan motor bearings.

4. Meter lamp Replacement

1. Remove power cable.
2. Remove 8 screws and top cover.
3. Slide METER two meter lamps (with grommets) from their keyed slots on the rear of the METER shield.
4. Desolder the leads from the circuit board adjacent to the power switch.
5. Replace the lamps in reverse order of disassembly. Meter lamp part number is B30-0817-15. These are rated 12 V, 40 mV.

5. AC voltage selection

The TS-930S will operate on 120, 220 or 240 V AC 50 or 60 Hz. For proper operation, select the power setting closest to your local line voltage.
If you are not sure of the local line voltage, contact the utility company. To reset the voltage selector, FIRST DISCONNECT THE POWER CABLE. Use a screwdriver align the selector to the correct voltage.

6. Ordering space parts

When ordering replacement or spare parts for your equipment, be sure to specify the following information:
Model and serial number of the equipment. Schematic number of the part. Printed circuit board number on which the part is located. Part number and name, if known, and Quantity desired.

NOTE:

A full Service Manual is available as a separate publication.

7. Service

Should it ever become necessary to return the equipment for repair, pack in its original boxes and packing, and include a full description of the problems involved. Also include your telephone number. You need not return accessory items unless directly related to the service problem.

You may return your radio for service to the Authorized Kenwood Dealer from whom you purchased it. A copy of the service report will be returned with the unit. Please do not send sub-assemblies or printed circuit boards. Send the complete unit, in its original boxes and packing.

SERVICE NOTE:

Dear OM, if you desire to correspond on a technical or operational problem, please make your note short, complete, and to the point. And PLEASE make it readable.

Please list: Model and serial number.
The question or problem you are having.

Please give sufficient detail to diagnose: other equipment in the station, meter readings and anything you feel might be usefull in attempting diagnosis.

NOTE:

1. Record the date of purchase, serial number and dealer from whom purchased.
2. For your own information, retain a written record of any maintenance performed on the unit.
3. When claiming warranty service, please include a photocopy of the bill of sale, or other proof of purchase showing the date of sale.

8. WARC bands

1. Unplug the AC power cable.
2. Remove the transceiver top cover (8 screws).
3. Remove four screws from the speaker mount and top panel assembly.
4. Swing the speaker top panel a way and unplug the battery backup leads (red/black) from the digital unit X54-1670-00.
5. As shown, carefully add a wire jumper from IC23, pin 12, to IC24, pin 8 (GROUND). For simplicity, this may be "tacked" on the component side of the P.C.B.
   Be certain not to pinch any leads under the speaker assembly.
6. This completes the modification.
   Reassemble the unit

■ ADJUSTMENT OF SIDE TONE LEVEL (AF-AVR UNIT)

Adjust VR1 to your preference.

■ ADJUSTMENT OF MONITOR LEVEL (IF UNIT)

Adjust VR8 to your preference.

8.4 TRANSMITTING ON WARC BANDS

As supplied, the TS-930S will receive but not transmit the 3 new WARC bands. If transmit capability is desired minor wiring addition is required.

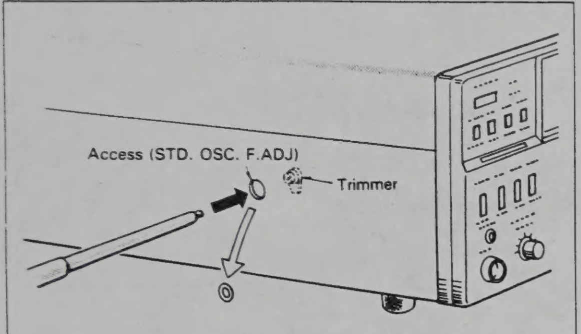


Fig. 8-3 Digital display calibration

5. Carrier balance adjustment (Signal unit)

With a 50 Ω dummy load connected to the ANT terminal, adjust for maximum output at 14.175 MHz. Reduce mic gain to zero. Set the transceiver in LSB mode. The power meter or an oscilloscope will deflect if the carrier is unbalanced. To balance the carrier, alternately adjust trimmer TC2 and trimpot VR-21 until the meter indicates minimum. Switch to USB mode and if the pointer deflects, readjust so the pointer deflects equally for both LSB and USB.

6. Side tone level adjustment (signal unit)

Adjust VR-32 for your preference.

7. "Buzzer" level adjustment (Signal unit)

Adjust VR-33 for your preference.

8. Monitor level adjustment (Signal unit)

Adjust VR-34 for your preference.

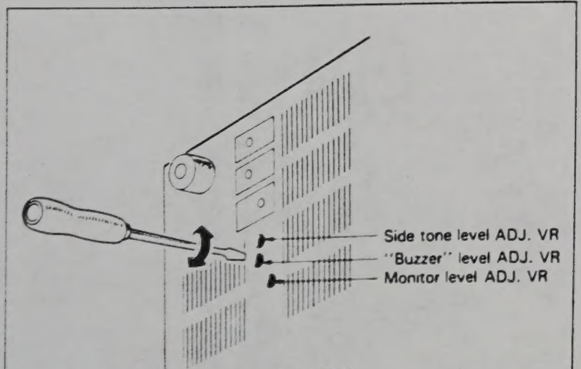


Fig. 8-4

9. S meter adjustment (Signal unit)

Disconnect the antenna with the transceiver in receive mode. Zero-point adjustment:
Adjust VR2 for meter pointer zero indication. If a standard signal generator (SSG) is available, adjust VR3 so the S-meter indicates "S-9", at 14.175 MHz for A 40 dB (50 μV) signal.

10. NOTCH adjustment (Signal unit)

Turn the MARKER switch on and tune for zero-beat in the TUNE mode.
Place the MODE switch to CW and turn the NOTCH switch on.
Adjust the NOTCH control to the 12 o'clock position and fine tune NOTCH for the notch point.
Adjust VR28 for minimum audio output. Repeat the NOTCH control and VR28 adjustments several times for best null.

8.3 MAINTENANCE

1. Semiconductors, resistors, and capacitors

Semiconductors are easily destroyed if a circuit is shorted. Troubleshoot carefully.
If a defective resistor or capacitor is to be replaced, use one of the same specifications.

2. Fuse

When the fuse blows, there is some cause. Be sure to find the cause before attempting operation. Use a 6 amp fuse for the TS-930S, or a 4 A fuse for the TS-930V for 120 V AC operation. Under no circumstances use a higher amperage fuse than specified. This can cause extensive damage. Also, the warranty will be void if an oversized fuse is used.

3. Fan motor lubrication

Every 6 months apply a drop of light machine oil to the front and rear fan motor bearings.

4. Meter lamp Replacement

1. Remove power cable.
2. Remove 8 screws and top cover.
3. Slide METER two meter lamps (with grommets) from their keyed slots on the rear of the METER shield.
4. Desolder the leads from the circuit board adjacent to the power switch.
5. Replace the lamps in reverse order of disassembly. Meter lamp part number is B30-0817-15. These are rated 12 V, 40 mV.

5. AC voltage selection

The TS-930S will operate on 120, 220 or 240 V AC 50 or 60 Hz. For proper operation, select the power setting closest to your local line voltage.
If you are not sure of the local line voltage, contact the utility company. To reset the voltage selector, FIRST DISCONNECT THE POWER CABLE. Use a screwdriver align the selector to the correct voltage.

6. Ordering space parts

When ordering replacement or spare parts for your equipment, be sure to specify the following information:
Model and serial number of the equipment. Schematic number of the part. Printed circuit board number on which the part is located. Part number and name, if known, and Quantity desired.

NOTE:
A full Service Manual is available as a separate publication.

7. Service

Should it ever become necessary to return the equipment for repair, pack in its original boxes and packing, and include a full description of the problems involved. Also include your telephone number. You need not return accessory items unless directly related to the service problem.

You may return your radio for service to the Authorized Kenwood Dealer from whom you purchased it. A copy of the service report will be returned with the unit. Please do not send sub-assemblies or printed circuit boards. Send the complete unit, in its original boxes and packing.

SERVICE NOTE:
Dear OM, if you desire to correspond on a technical or operational problem, please make your note short, complete, and to the point. And PLEASE make it readable.
Please list: Model and serial number.
The question or problem you are having.
Please give sufficient detail to diagnose: other equipment in the station, meter readings and anything you feel might be usefull in attempting diagnosis.

NOTE:
1. Record the date of purchase, serial number and dealer from whom purchased.
2. For your own information, retain a written record of any maintenance performed on the unit.
3. When claiming warranty service, please include a photocopy of the bill of sale, or other proof of purchase showing the date of sale.

8. WARC bands

1. Unplug the AC power cable.
2. Remove the transceiver top cover (8 screws).
3. Remove four screws from the speaker mount and top panel assembly.
4. Swing the speaker top panel a way and unplug the battery backup leads (red/black) from the digital unit X54-1670-00.
5. As shown, carefully add a wire jumper from IC23, pin 12, to IC24, pin 8 (GROUND). For simplicity, this may be "tacked" on the component side of the P.C.B.
   Be certain not to pinch any leads under the speaker assembly.
6. This completes the modification.
   Reassemble the unit

■ ADJUSTMENT OF SIDE TONE LEVEL (AF-AVR UNIT)

Adjust VR1 to your preference.

■ ADJUSTMENT OF MONITOR LEVEL (IF UNIT)

Adjust VR8 to your preference.

8.4 TRANSMITTING ON WARC BANDS

As supplied, the TS-930S will receive but not transmit the 3 new WARC bands. If transmit capability is desired minor wiring addition is required.

SECTION 9. TROUBLESHOOTING

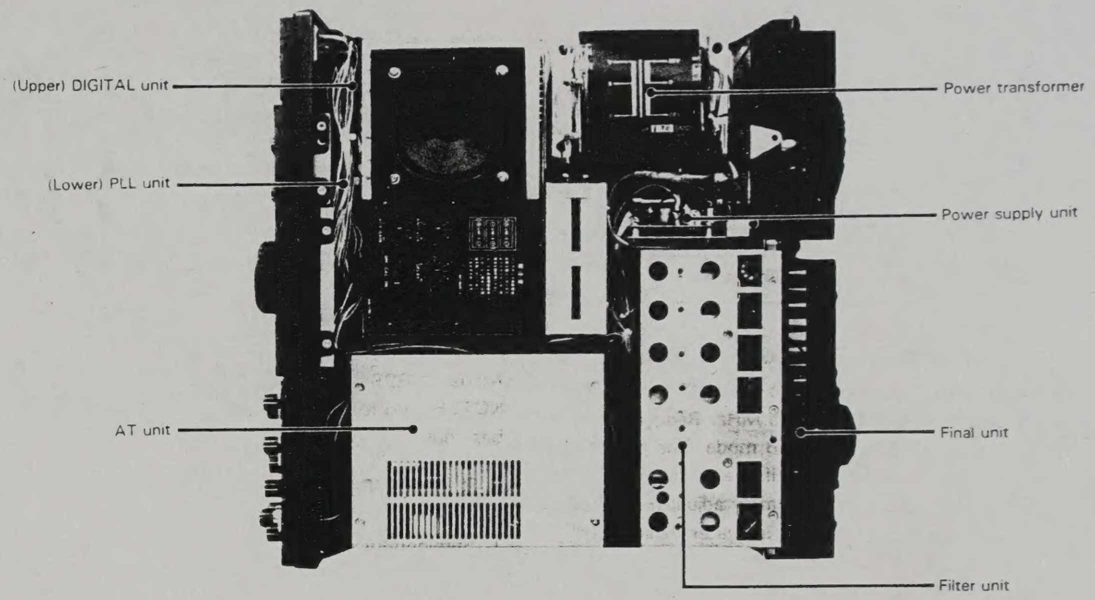
TRANSMITTER SECTION

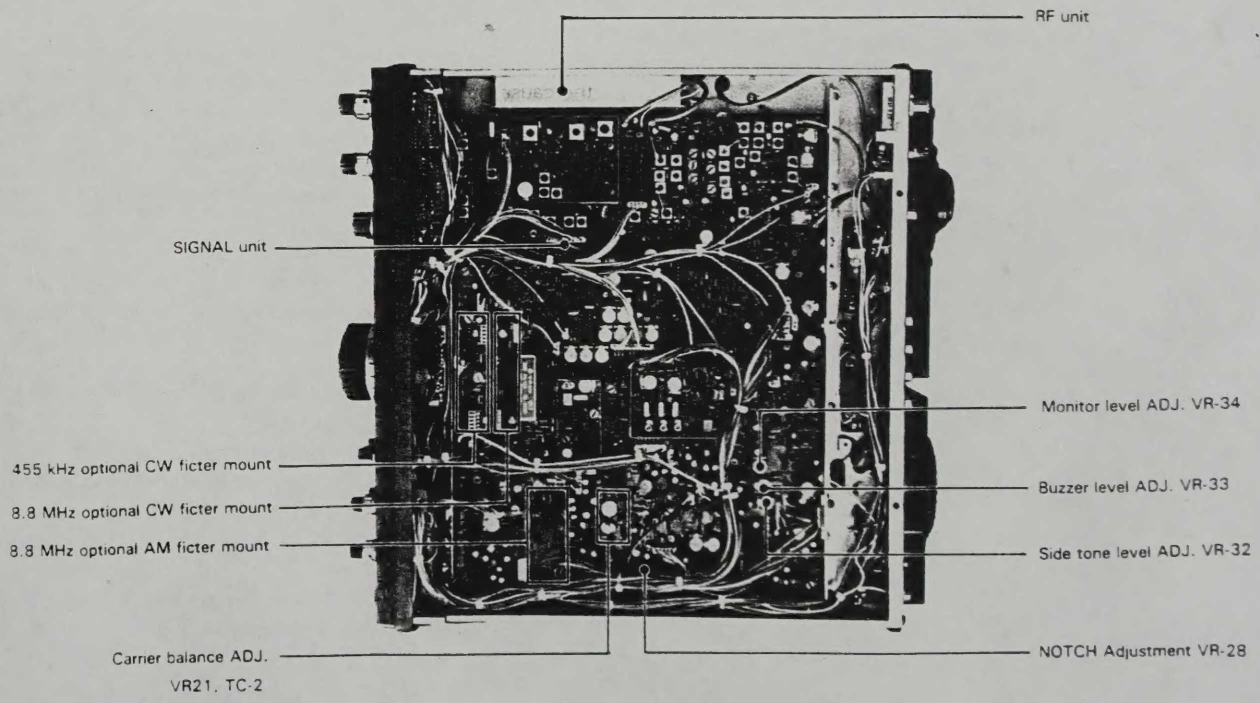
SYMPTOM	CAUSE	REMEDY
No output in SSB (No Ic.)	1. Open microphone cable or bad microphone 2. Low microphone gain. 3. PROC switch is to ON with PROC IN/OUT control fully counterclockwise.	1. Check the microphone. 2, Increase the mic Gain. 3. Increase the PROC IN/OUT settings.
VOX does not operate.	1. VOX GAIN control too low. 2. ANTI VOX control requires adjustment.	1. See section 5.4.7, VOX operation. 2. See section 5.4.7, VOX operation.
VOX trips by speaker output.	ANTI VOX control requires adjustment.	See section 5.4.7, VOX operation
Mic or radio chassis is ''hot'' during TX.	Excess RF in the shack. No earth ground, poor ground, or antenna is too close to the radio.	See section 3.8, 3.9.
Poor audio in SSB, TX-feedback.	Excess RF in the shack.	See section 3.8, 3.9.

RECEIVER SECTION

SYMPTOM	CAUSE	REMEDY
Lights do not light and there is no receiver noise when the POWER switch is turned on.	1. Bad power cable or connections. 2. Blown power supply fuse.	1. Check cables and connections. 2. Check for the cause of the blown fuse and replace the fuse.
An antenna is connected but no signals are heard.	Microphone PTT switch (or stand-by switch) is in the transmit position.	Release the PTT switch
An antenna is connected but S-meter deflects without a received signal.	1. RF GAIN control closed. 2. Low AC line voltage.	1. Open RF GAIN control. 2. Use a step-up transformer to raise the line voltage.
SSB signal unintelligible.	MODE switch is set to wrong sideband.	Turn MODE switch to the correct sideband.
RIT control inoperative.	RIT switch is off.	Push RIT button.
SSB received signal is extremely high cut or low cut.	Slope tuning is out of adjustment.	Set to the NORMAL position.

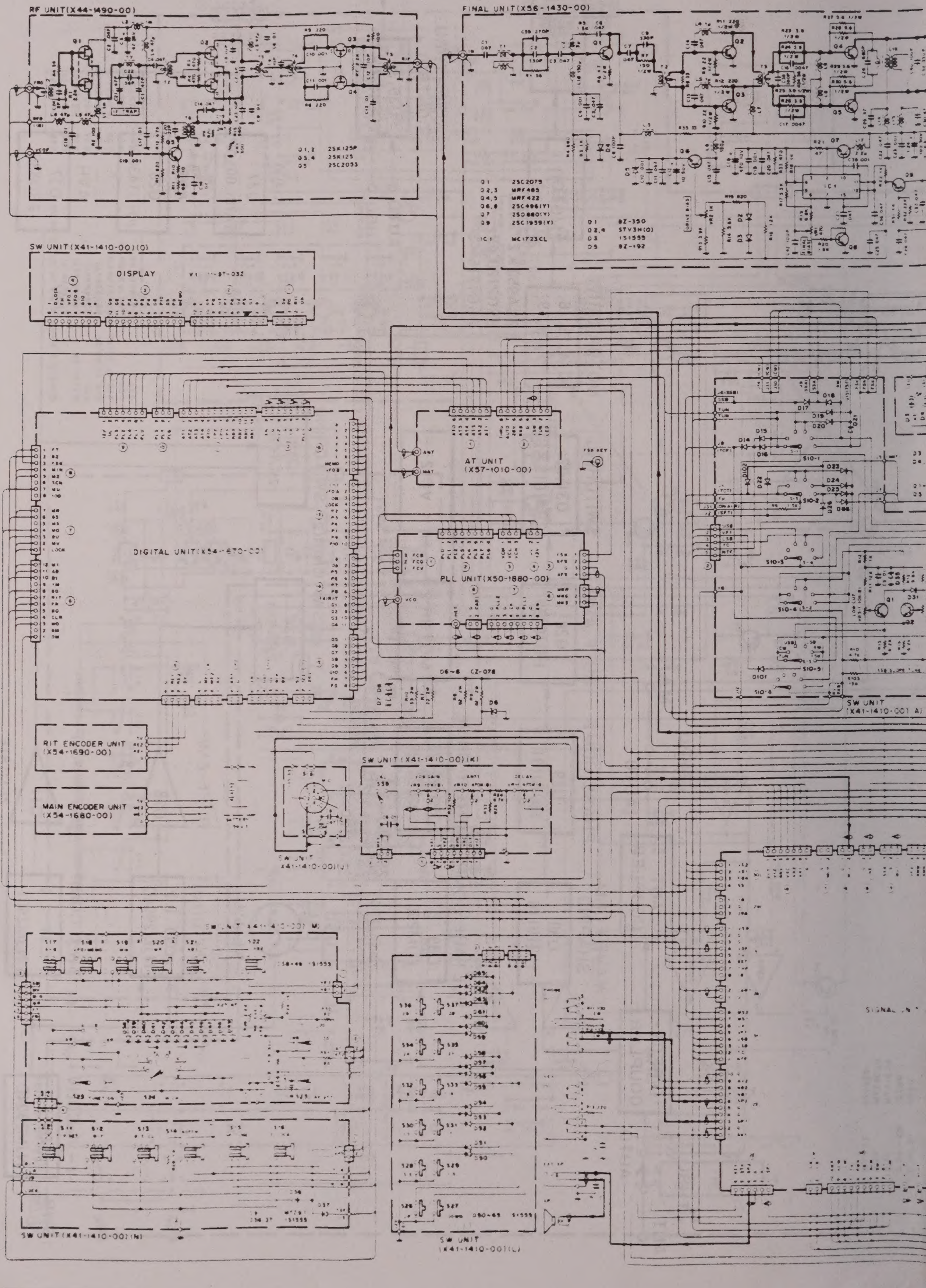
SECTION 10. INTERNAL VIEWS


(Upper) DIGITAL unit
(Lower) PLL unit
AT unit
Power transformer
Power supply unit
Final unit
Filter unit


RF unit
SIGNAL unit
455 kHz optional CW ficter mount
8.8 MHz optional CW ficter mount
8.8 MHz optional AM ficter mount
Carrier balance ADJ.
VR21, TC-2
Monitor level ADJ. VR-34
Buzzer level ADJ. VR-33
Side tone level ADJ. VR-32
NOTCH Adjustment VR-28

SECTION 12. CIRCUIT DIAGRAMS

SCHEMATIC DIAGRAM


RF UNIT(X44-1490-00)
IF TRAP
Q1,2 2SK125P
Q3,4 2SK125
Q5 2SC2053
FINAL UNIT(X56-1430-00)
Q1 2SC2075
Q2,3 MRF485
Q4,5 MRF422
Q6,8 2SC496(Y)
Q7 2SD880(Y)
Q9 2SC1959(Y)
IC1 MC1723CL
D1 BZ-350
D2,4 STV3H(O)
D3 1S1555
D5 BZ-192
SW UNIT(X41-1410-00)(O)
DISPLAY
DIGITAL UNIT(X54-670-00)
AT UNIT (X57-1010-00)
ANT
MAT
PLL UNIT(X50-1880-00)
VCO
D6~8 CZ-078
RIT ENCODER UNIT (X54-1690-00)
MAIN ENCODER UNIT (X54-1680-00)
SW UNIT (X41-1410-00)(K)
SW UNIT X41-1410-00)(J)
SW UNIT (X41-1410-00)(M)
SW UNIT(X41-1410-00)(N)
SW UNIT (X41-1410-00)(L)
SW UNIT (X41-1410-00) A)
SIGNAL UNIT